

Smart Hoop Boxscore

Group 18

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# **1.Executive Summary:**

When you want to know who's winning a game, you check the score. Even if you play a game by yourself, you probably still keep score. At every level of sports, from street ball to professional basketball, the score is an essential part of every game. This, in turn, makes the scorekeeper an essential official. However, the kind of person who fills the role varies based on the league. A scorekeeper might be a volunteer parent for a children's league, a student earning minimum wage for a college intramural league or an experienced league official working full-time for a professional sports team. For this paper specifically, we will focus on designing a device that can automatically record not only which team scored but also which player scored.

In our project, the concept that we are trying to bring to life is to not only replace a scorekeeper with a more dependable system but we also would like to replace the stat keeper, because not only will our system be able to keep score, and will also be able to Figure out who scored and how many points they scored throughout the game. This product will help not only professional level basketball playing but also right here at the University of Central Florida. IM leagues, because, even at the professional level, there is no shortage of scorekeepers and stat recorders at the lower levels and recreation levels. There is a huge shortage of that kind of personnel. Our product will be mainly to help the elementary, middle, high school and college students that enjoy playing basketball, as well as the thousands of people that play basketball at public parks and in gymnasiums all across the country.

This project is interdisciplinary as a senior design group, because we have three electrical engineering students and a computer engineering student. With the collaboration of everybody within our group, we hope to be able to see this project flourish under the guidance of our amazing professors. This project will force us to use not only wireless communication, but it also makes us utilize some kind of stored energy and sensors that we have not used so far at this university such as laser, proximity, sensors or HD camera units. This project will also test our creative thinking because of the plethora of components that are able to satisfy our requirements for building this prototype we could use a Wi-Fi chip or a Bluetooth chip. There's also a plethora of different sensors that we could use if not a laser proximity sensor we would be able to use an ultrasound sensor or a push button physical sensor. There are a multitude of different ways to approach this problem.

Our preliminary ideas are to hopefully use wireless communication as in a Wi-Fi chip on the unit as well as keep it powered by a rechargeable battery. Not only will this

let the unit be able to be utilized at more than one location, but it will also help make the system more desirable because you would only need two units for any game anywhere because of the portability of the units. We also believe that we will be attaching the units directly to the net, and the net will have to be removed each time you want to use the system on another hoop. The reason that the net would have to be removed is because we plan on using 3 to 6 ultrasonic sensors attached to the net at various locations so that the reading from these sensors are as accurate as possible having this many sensors attached to the basketball net will also help determine the reading, if the Basketball came in the wrong side, that way there will be no false scoring and it helps with error control. We hope to be able to 3-D print all of the unique components of the unit so that we can minimize the size and make the most efficient design .

We've been able to look into a multitude of different projects, based around a similar principle from other universities, Senior design projects, as well as our own University of Central Florida. In our research we have been able to find a corn hole scoring device, as well as a Foos ball scoring device and a field goal score keeping device. All of these different projects, have the same principle as ours, which is keeping score of a sport or game. In all of our research and investigation, the old projects helped the most with useful and interesting avenues to investigate so that we can build and prototype the most effective and cost-effective Senior design project possible within our research. We've also been able to find an incredible array of components that have only the most minute differences, with all of the research we believe that we have been able to find which devices and components will hopefully combine into the best final product . We've also been able to brainstorm with our professors and other engineers in the field to try and create the most practical and affordable final product. With our professors, guidance and the plethora of related projects and useful information on the Internet, we believe that we will build the best case scenario product for this Senior design project.

Our Senior design project has some very realistic design constraints, including economic, environmental, and health and safety problems, which we will hopefully be able to address and find useful solutions in the near future. Some of the environmental concerns include and are not limited to when, using any type of laser detection. The amount of light in the system affects how well our readings are affected. Also, if we are to make this product usable for outdoor courts as well, then we would have to make the entire unit waterproof so that the weather will hopefully not make the unit erode or break due to water damage. The last environmental factor is depending on where we would set up the unit. It Has to be in a place that is either locked down so that no one can steal it or in a very hard to reach place just for the units anti theft. it's economic constraints, include but are not limited to its overall cost to produce. The unit must be within reason because most of the people purchasing this unit will either be private citizens or hopefully it will

be purchased by professional teams and collegiate organizations. Finally, the last and probably most important constraint is due to safety not only does a basketball rim vibrate vigorously during a game, but it needs to be fashioned sturdily so that it does not hurt a player or destroy the unit. With these three design constraints, we hope to still be able to produce the most effective and useful final product for our Senior design project.

## **2. Project Description:**

### **2.1 Motivation:**

The motivation behind this project was from playing on an intramural sports team at UCF where proper tallying of the score was almost non-existent and would often cause issues between teams. Especially in playoffs and when scores were close. In order to avoid future human error we decided to come up with a smart box score system that would be able to identify players on a team and when that said player scored to keep proper stats of the game. The goal we have in mind is to create something that would be interactive, accurate, and easy to use. For the detection of players we are considering using a smart cam and writing a certain code in order to achieve our results.

With the vast amount of people that play basketball on a daily basis, having a way to keep score without having to designate a specific person, is sorely lacking within the Basketball industry today. Our team has competed in elementary middle high school, and IM right here at the University of Central Florida, with all of these levels of basketball, they all have the same problem there needs to be a designated person, keeping count of the score, as well as being able to count statistics for the team. Without these very important people, playing basketball becomes a fun game instead of a sport or something to compete in. Without being able to keep score, would have disastrous outcomes for basketball on all levels. With our product not only will there be no need for a person to be hired or trained in these two positions, but there will be very minimal error because of the AI. Our AI is smarter and faster reacting than any scorekeeper there is today. We believe that we will be able to revolutionize the industry and keep human error to a minimum.

### **2.2 Project Narrative:**

#### **Goals:**

The project goal is to be able to test develop and have a working prototype by the end of the year. Our unit will be able to not only count how many baskets are made in a specific hoop, but also differentiate which players are scoring. Hopefully once our prototype is developed, we will be able to scale up our operation and have an entire game without a scorekeeper or statistics keeper. We hope to be able to revolutionize Basketball

on all levels, but mainly right here at the University of Central Florida playing IM Basketball.

**Objective:**

We want to design and implement embedded systems and AI technology together into a basketball hoop. The result of the project is to have a camera that detects which player is shooting the ball, the basketball will be detected when a basket is made, and update a boxscore with the made basket and corresponding player. It will be made up of three key components that will be integrated together: a Smart camera capable of image recognition, a piece of hardware mounted to the hoop to detect made baskets, and a React App that will be updated following those two. The way that the smart hoop box score system would work is by having either a laser light detection or range finder in order to detect when the basket is made.

**2.3 Possible System Implementation Summaries:**

Our Possible System Implementation is to hopefully use wireless communication as in a Wi-Fi chip on the unit as well as keep it powered by a rechargeable battery. Not only will this let the unit be able to be utilized at more than one location, but it will also help make the system more desirable because you would only need two units for any game anywhere because of the portability of the units. We also believe that we will be attaching the units directly to the net, and the net will have to be removed each time you want to use the system on another hoop. The reason that the net would have to be removed is because we plan on using 3 to 6 ultrasonic sensors attached to the net at various locations so that the reading from these sensors are as accurate as possible having this many sensors attached to the basketball net will also help determine the reading, if the Basketball came in the wrong side, that way there will be no false scoring and it helps with error control. We hope to be able to 3-D print all of the unique components of the unit so that we can minimize the size and make the most efficient design .

Our unit will be able to not only count how many baskets are made in a specific hoop, but also differentiate which players are scoring. With our revolutionary project we can change the face of basketball. Hopefully once our prototype is developed, we will be able to scale up our operation and have an entire game without a scorekeeper or statistics keeper. We hope to be able to revolutionize Basketball on all levels, but mainly right here at the University of Central Florida playing IM Basketball. We will also be able to move basketball into the future with our AI score keeper and statistics tracker.

## Process/Development Breakdown:

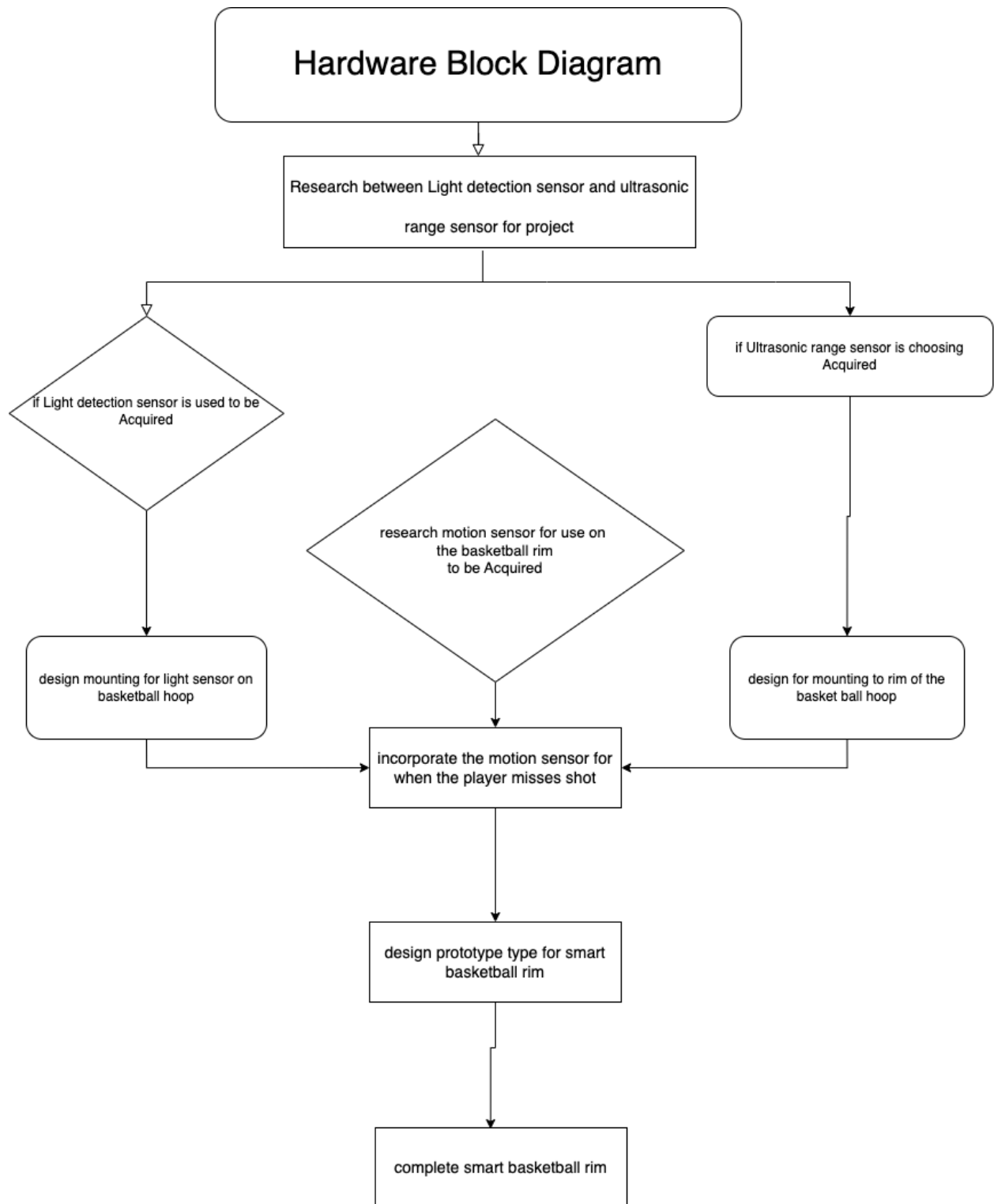
- Mini Hoop
- Boxscore App: use Node React & Expo Go with super simple UI and formatting
- Make Detection:
  - Can use laser light detection. Place a laser at the 'box' of the rim and when the laser is broken count it as a make to update the app.
  - Or can use 'Range Finder' from JD, also placing it at the 'box' of the rim. Now detect for "if range <= (diameter of rim)" to count as make. \*this might not work depending on how fast it can detect a range, ie. the ball might fall through hoop too fast for range finder to detect\*
- Miss Detection:
  - Can use an arduino motion sensor on the side of the hoop. And set it up to detect motion (ball). Use two conditions.
    - (1) motion() & make() == make
    - (2) motion() & !make() == miss
  - Can use the same joystick Texas Instrument from embedded systems and place it at 'box' of hoop. With the joystick at (0,0) as base. If a miss hits the rim or hoop it should displace the joystick from base. Then use the same conditions.
    - (1) if displaced() & make() == make
    - (2) if displaced() & !make() == miss
- Smart Cam: Using TensorFlow and a custom database. Very similar to the SmartCam Javier made in Fall '22.
  - To keep it simple: Create a 'Group 18' Team on the Boxscore App.
  - Roster: Javier, Luciano, Sierra, Erik
  - Then upload ourselves into the database. Using pictures of us doing basic basketball shots.
- Another Idea to make it even simpler. Could do team boxscore/field goal tracking
  - This could make it easier because then the smart cam would only have to detect colors (home vs. away)
  - If home is ALWAYS white then this would make this even EASIER. Bc then Smart Cam would only have to detect between white & any other color. Might be a good idea to start with that.

## Divide and Conquer:

1. Create a super basic React App:

- a. Only two buttons: make() and miss()
  - b. With a counter fraction in center: x/y
    - i.  $x = \text{made shots}, y = \text{total attempts}$
  - c. pressMake() => x++ & y++
  - d. pressMiss() => y++
2. Configure makeDetector to trigger an action on the board it's on: laser or rangeFinder.
  - a. On the same display as the range show a counter @ 0:
   
if range <= (hoopDiameter): counter++
  - b. On arduino/raspberryPi display counter @ 0: on laserBroken(): counter ++
3. If two is successful attach makeDetector to hoop and test.
4. Connect app and makeDetector. So that a make or miss updates the boxscore counter.
5. Reformat App: Keep boxscores but only of total team stats, no players on a roster yet. only Home vs Away.
6. Setup Smart Cam. Create our own database for Home vs Aways teams.
  - a. Home will be white.
  - b. Away will be all colors not white.
  - c. Test to see if cam will detect white shirts/jerseys as 'Home' and else as 'Away'
7. Find How to connect Smart Cam to Boxscore App.
  - a. If 'Home' is inFrame() & miss() = update boxscore as a miss for Home
  - b. If 'Home' is inFrame() & make() = update boxscore as a make for Home
  - c. " " " for Away
  - d. " " " for Away
8. If all works this could be the project.
9. Or if enough time we could try to do it with players on a roster instead of just teams.
  - a. Just would have to gather tons of data for each player on the roster.

Block diagram:





**List of expenses:**

Items required for Smart Hoop	Cost
Smart Cam	\$0
Ultrasonic range sensor	\$0
Light Detection sensor	\$9 - \$25
arduino/raspberryPi display	\$13 - \$79
Mini hoop	\$0
Motion detection sensor	\$3 - \$25
Misc.	\$100
Total	\$125 - \$229

**Milestones/Timeline:**

Task	Duration	Status
Senior Design 1 and Documentation		
BrainStorming	January 9th 2023	Complete
Project Selection	January 25th 2023	Complete
Initial Document- Divide and Conquer	January 30th 2023	In Progress
Research Component List	February 15th 2023	In Progress
Schematic Capture	March 15th 2023	Researching
Bill of Material	March 17th 2023	Researching
Table of Contents	March 27th 2023	In Progress
45 Page Document	April 2nd 2023	TBD
75 Page Document	April 10th 2023	TBD
90 Page Document	April 20th 2023	TBD

Order Parts and PCB	April 20th 2023	In Progress
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### Meeting Times:

Meeting date	Duration	Use
January 9th 2023	1 Hour	Team Creation
January 11th 2023	30 Minutes	BrainStorming
January 13th 2023	1 Hour	BrainStorming
January 18th 2023	30 Minutes	BrainStorming
January 20th 2023	30 Minutes	BrainStorming
January 23th 2023	1 Hour	BrainStorming
January 25th 2023	1 Hour	Project Selection
January 27th 2023	2 Hour	Researching
January 30th 2023	1 Hour	Researching
February 3th 2023	30 Minutes	Initial Document- Divide and Conquer
February 7th 2023	30 Minutes	Researching
February 9th 2023	1 Hour	Researching
February 16th 2023	30 Minutes	Researching
February 21th 2023	30 Minutes	Researching
February 23th 2023	1 Hour	Researching
February 28th 2023	30 Minutes	Researching
March 2th 2023	1 Hour	Researching
March 7th 2023	30 Minutes	Researching
March 9th 2023	1 Hour	Researching
March 21th 2023	30 Minutes	Researching
March 23th 2023	1 Hour	Researching

March 28th 2023	30 Minutes	Researching
March 30th 2023	1 Hour	Researching
April 4th 2023	30 Minutes	Researching
April 6th 2023	1 Hour	Researching
April 11th 2023	30 Minutes	Researching
April 13th 2023	1 Hour	Researching
April 18th 2023	30 Minutes	Researching
April 20th 2023	1 Hour	Purchase components