Swish Trainer

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1 Introduction

1.1 Objective

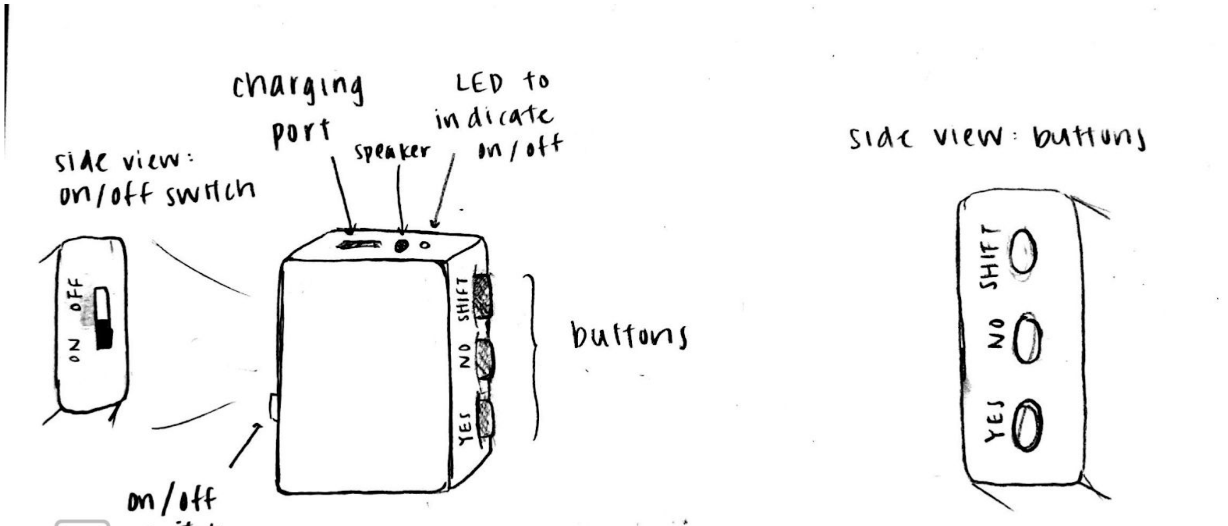
Due to the advent of the COVID-19 pandemic, many people wanting to shoot some hoops find themselves at the court alone. There's already variations of rebound machines, self-trainers, and passing machines. But these are either not portable and too expensive for your average player or they are too simple to effectively help in all the ways that players need. What we are proposing is a self-trainer, built for the average hooper. Someone who doesn't have access to various trainers, machines, and regimens but still wants to put in work, anywhere.

We are proposing a combination of a remote and an app to solve this issue. First, a portable remote that can be attached to a piece of clothing or worn around the person's wrist who is shooting collects the data of which shots are made and where they are being made from. These predetermined spots around the court should be set on the app, and the remote would have a yes and no button that the shooter has to click to account for the success rate of the shot. The remote will also have a shift button to let the app know when a person is switching spots around the court. The app itself will be present to view the results and input the spots the shooter wants to shoot from. The app will take all this data of the shots taken from all these varying spots and create a report of percentages from different spots around the court and analyze what spots the person would have to work and more. It would report percentages for each day/session and save the varying percentages under each date

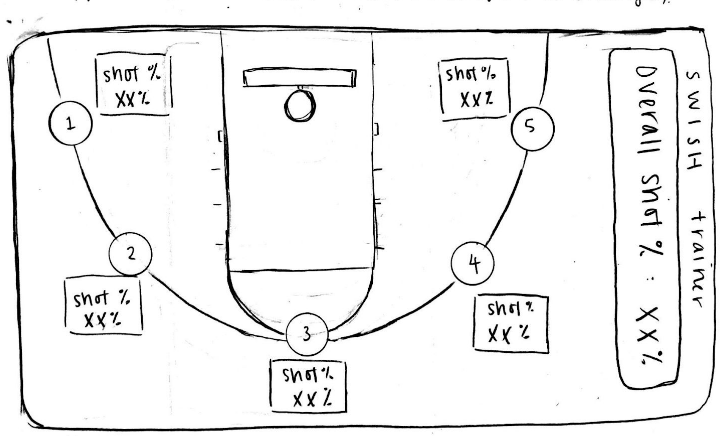
1.2 Background

Our problem has always existed, in that every day hoopers have never really had anything like this that helps track shooting statistics. However, our problem has been exasperated recently by the advent of the COVID pandemic. Now, hoopers are expected NOT to ball with each other and instead either stay home or shoot around by themselves. With this in mind, it is now even harder to get a productive training session by yourself.

1.3 Physical Design



app interface sketch (exact UI subject to change)



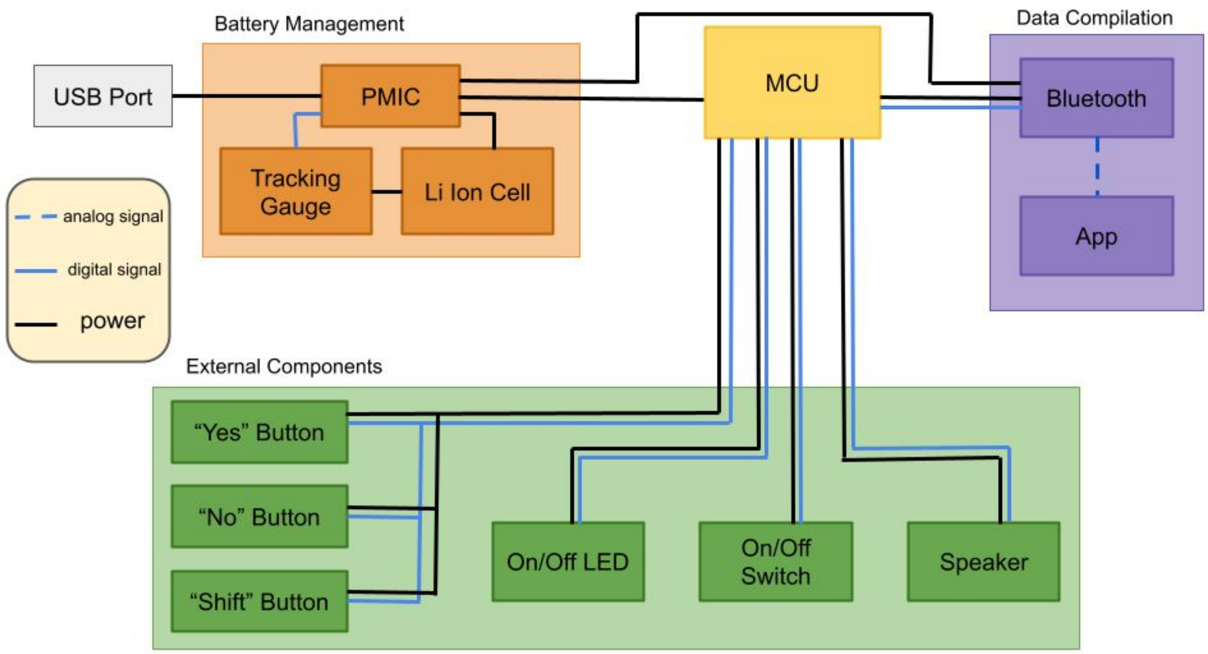
1.4 High-Level Requirements

- The remote has to read the correct input from the user. When a button is pressed, an audio confirmation must be heard. When the device is switched on, the LED must turn on.
- The remote has to relay the correct inputs into the app connected via bluetooth to the phone. We should be able to see this as the values update in real time.

- Our app must accurately display shot percentages from at least 5 different spots throughout a basketball court. We can clearly see this as the interface we plan to create on this app is a half court that shows the percentages of the shots at varying points.

2 Design

2.1 Block Diagram



In this block diagram, the external components are directly connected to the microcontroller. Signals coming from the buttons and the on/off switch are registered in the microcontroller, the microprocessor sends a signal to the external components to reflect the correct outcome (i.e. if the switch is in the “on” position, then the on/off LED will light up; if a button is pressed, the speaker will play a beep). The bluetooth block is also directly connected to the microcontroller, so signals sent to the microcontroller from the buttons can be sent to the bluetooth block and communicated to the app. The app can then perform the necessary calculations to correctly display the shot percentage.

2.2 Battery Management

The Battery Management system is needed to provide power to the microcontroller as well as the rest of the components.The PMIC will charge the Lithium Ion battery and the Tracking Gauge will tell us how much battery the system has.

2.2.1 PMIC

The Power Management Integrated Circuit or (PMIC) will be responsible for charging the system and providing power.

Requirement:

2.2.2 Lithium Ion Cell

The Lithium Ion Battery will power the microcontroller as well as the rest of the components through the microcontroller.

Requirement: The Lithium Ion Battery must be able to keep the system powered continuously for a set amount of hours. The battery must also be small enough to fit in a roughly smartphone sized device.

2.2.3 Tracking Gauge

The tracking gauge will provide information such as remaining battery capacity, state of charge, and battery voltage. This is a sensor feeding back to the PMIC.

Requirement:

2.3 Microcontroller

The microcontroller reads I/O information from the Yes, No, Shift, On, Off buttons and will also power the speaker and the LED in the external components. The microcontroller will then store this I/O information in its data memory where it will then apply this data to communicate through a bluetooth device to our app.

Requirement: The microcontroller may store a set amount of data before transmitting to the app, if this is the case there will be a future flash memory requirement here.

2.4 Data Compilation

The data compilation part of this project entails a bluetooth device that connects the remote to the other part which is an app. The app does the brute of the calculations and analysis of this project.

2.4.1 Bluetooth

The bluetooth device we are going to use connects the remote wirelessly to the app making the relaying of information from the varying buttons on the remote easy and efficient.

Requirement: The bluetooth device must connect to the app successfully and relay the correct values to the app.

2.4.2 App

The app itself takes in all the varying inputs of the remote and receives this data via bluetooth. The app then portrays all the shots taken from the varying spots on the court. The interface of this app consists of a half basketball court and the five spots the person is shooting from and shows the percentages from each of these spots.

Requirement: The app must be able to read the values of the inputs coming through via bluetooth and display the correct values and suggestions derived from that data.

2.5 External Components

The external components on this project consist of three buttons, a switch, a LED, and a speaker. All these components are relevant in taking in input and for the user to recognize that the input was taken successfully.

2.5.1 “Yes”, “No”, “Shift” buttons

These three buttons are what the user must press. The “yes” button should be pressed if the shot goes in. The “no” button should be pressed if the shot is missed. The “shift” button should be pressed if the shooter is moving to the next spot in the shooting rotation. These three buttons encompass the external inputs that are involved in our project.

Requirement: These buttons must be able to register correctly to relay and calculate everything else throughout this project.

2.5.2 “On/Off” Switch

The “on/off” switch’s purpose is to turn the remote on or off respectively. This allows for power to flow throughout the board and saves energy when the remote is off.

Requirement: This switch must be operational for the entire remote to work.

2.5.3 LED & Speaker

The LED and speaker are present to let the user know that the buttons and switch are working correctly. The LED will light up when the remote is on and will be off respectively if the remote is off. The speaker will make a beep if the “yes” button is pressed, two beeps if the “no” button is pressed, and three beeps if the “shift” button is pressed.

Requirement: The LED and speaker must be functional for the user’s convenience in a sense that they would know the remote is working correctly.

2.6 Risk Analysis

The microcontroller block poses the greatest challenge in this project because it needs to power and communicate with the external and bluetooth block. If we incorporate data from sensors in the microcontroller into our project, we will need to correctly calibrate those sensors to ensure the correct results are reported on the app.

3 Ethics & Safety

There are a few safety concerns with our project. Primarily, the use of a lithium ion battery does provide us with some challenges. Damage to lithium ion batteries can occur when they are dropped, crushed, or punctured. Additionally, damage can occur when temperatures are too high (above 130°F), or if the batteries are charged in temperatures below 32°F.

If a lithium ion cell is damaged, then the possible heat release from this damage can result in thermal runaway which is when this excess heat damages other cells which leads to a chain reaction of heat release. Additionally, during thermal runaway the excess byproducts released from this process may ignite or cause other harmful side effects.

In order to ensure that lithium ion cell runaway or other damage does not occur, we will monitor the temperature with a thermistor and immediately isolate the battery from the rest of the system if the temperature reaches above 115°F or below 32°F. Additionally, we will make sure our PMIC does not charge the lithium battery over 4.21 V. These precautions are in strict adherence to the IEEE Code of Ethics #1: "to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, to protect the privacy of others, and to disclose promptly factors that might endanger the public or the environment" [2].

In terms of privacy laws with respect to the app, we can secure the data to simulate an ethical and private. This is not much of a necessity to us as the information and data we have is not higher-level information that could potentially cause harm to the user of this data is leaked. If we did want to secure the app despite this, we would have to write encrypted code along with following all the privacy laws set in place by the app store at the current time.

4 References

[1] "Battery Management Reference Design for Smartwatch & Wearable Applications." Oct. 2015.<https://www.ti.com/lit/ug/tidub09/tidub09.pdf?ts=1613346750822&ref_url=https://www.ti.com/sitesearch/docs/universalsearch.tsp?searchTerm=block diagram for smart watch> [Accessed 16 February 2021].

[2] "IEEE Code of Ethics," *IEEE*. [Online]. Available: https://www.ieee.org/about/corporate/governance/p7-8.html. [Accessed: 16-Feb-2021].

[3] Lutkevich, B., 2021. *What is a Microcontroller and How Does it Work?*. [online] IoT Agenda. Available at: <https://internetofthingsagenda.techtarget.com/definition/microcontroller> [Accessed 16 February 2021].

[4] “UNITED STATES DEPARTMENT OF LABOR,” *Safety and Health Information Bulletins | Preventing Fire and/or Explosion Injury from Small and Wearable Lithium Battery Powered Devices | Occupational Safety and Health Administration*. [Online]. Available: https://www.osha.gov/dts/shib/shib011819.html#:~:text=flashlights, and defibrillators.-,Hazards,fire and/or explosion hazard. [Accessed: 16-Feb-2021].

[5] “Wearables,” *Wearables Solutions*. [Online]. Available: https://www.cypress.com/solutions/wearables-solutions. [Accessed: 16-Feb-2021].