

Team 26: Defuse It or Lose It!

University of
Massachusetts
Amherst

BE REVOLUTIONARY™



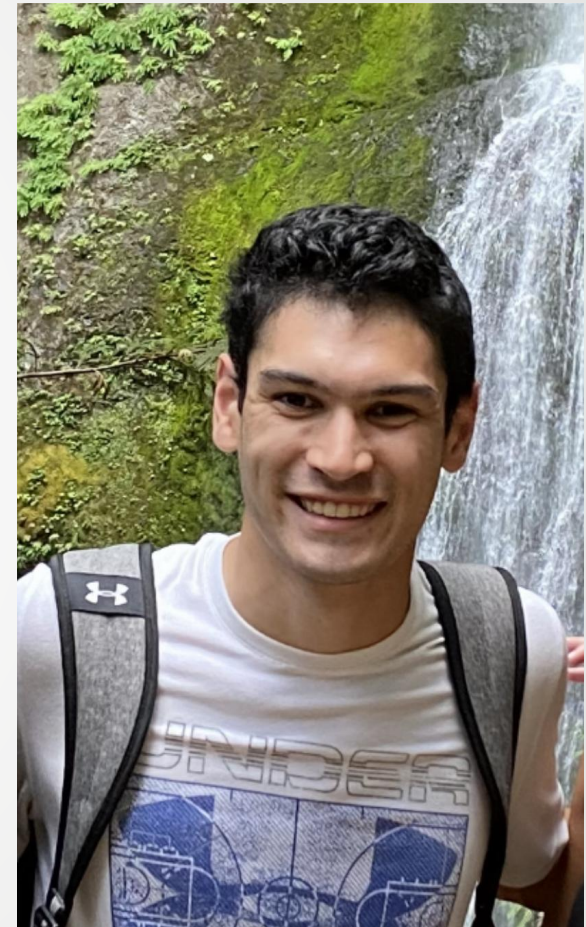
Team Members



Ethan LaFleur - Electrical Engineer



Krishna Vijayakumar - Computer Engineering



Edward "Matt" Buiser - Computer Engineering

Problem Statement

Technology such as video game consoles, or virtual reality systems are not available to many people. Also many people who did not grow up with this type of technology have a difficult time traversing the digital landscape. This limits the exposure of online games. Our solution will bring an online game: Keep Talking and Nobody Explodes to the tabletop. It will eliminate the need for technology and will be more appropriate for all types of people.

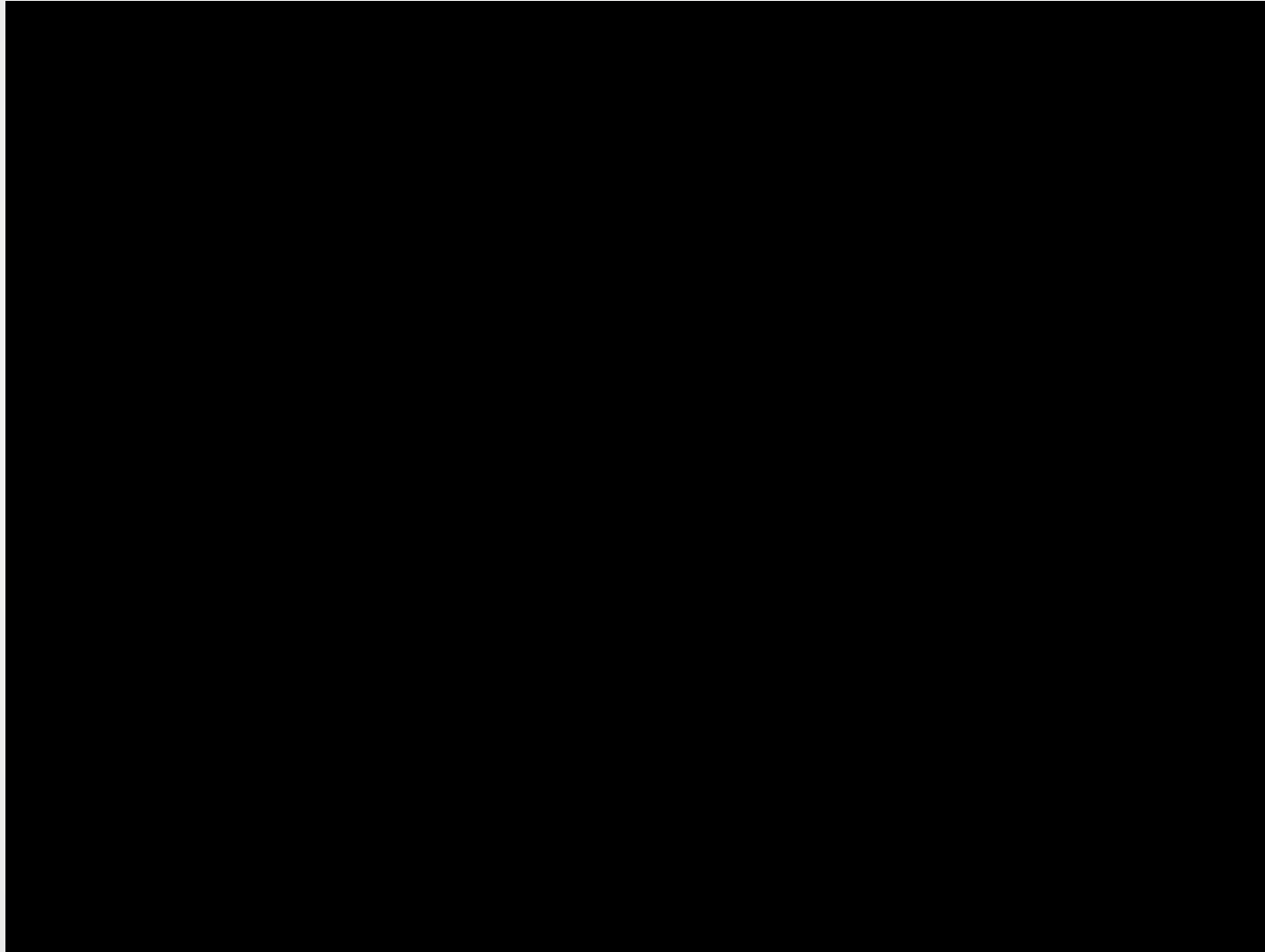
System Specifications

- ❑ Uses a physical “bomb” with modules already installed
- ❑ Randomizes each individual module every time a new level starts
 - ❑ Must feel random to player
 - ❑ At least over 20+ level configurations for all modules
- ❑ Includes difficulties in the form of levels that a user can set before each run
 - ❑ Automated in game, affects each game differently, overall time may be lower as it increases
 - ❑ 5+ difficulty levels
- ❑ Includes at least 2 regular modules and 1 “needy” module
 - ❑ Simon Says
 - ❑ Password Game
- ❑ Modular approach
 - ❑ One master module to keep track of all game modules
 - ❑ Each module contains its own information and ruleset
 - ❑ Communication between modules
- ❑ Rechargeable power source capable of 30 hours of gameplay at a time
- ❑ Manual will be converted to an app
 - ❑ Selectable options for modules on app
 - ❑ Send difficulty via app

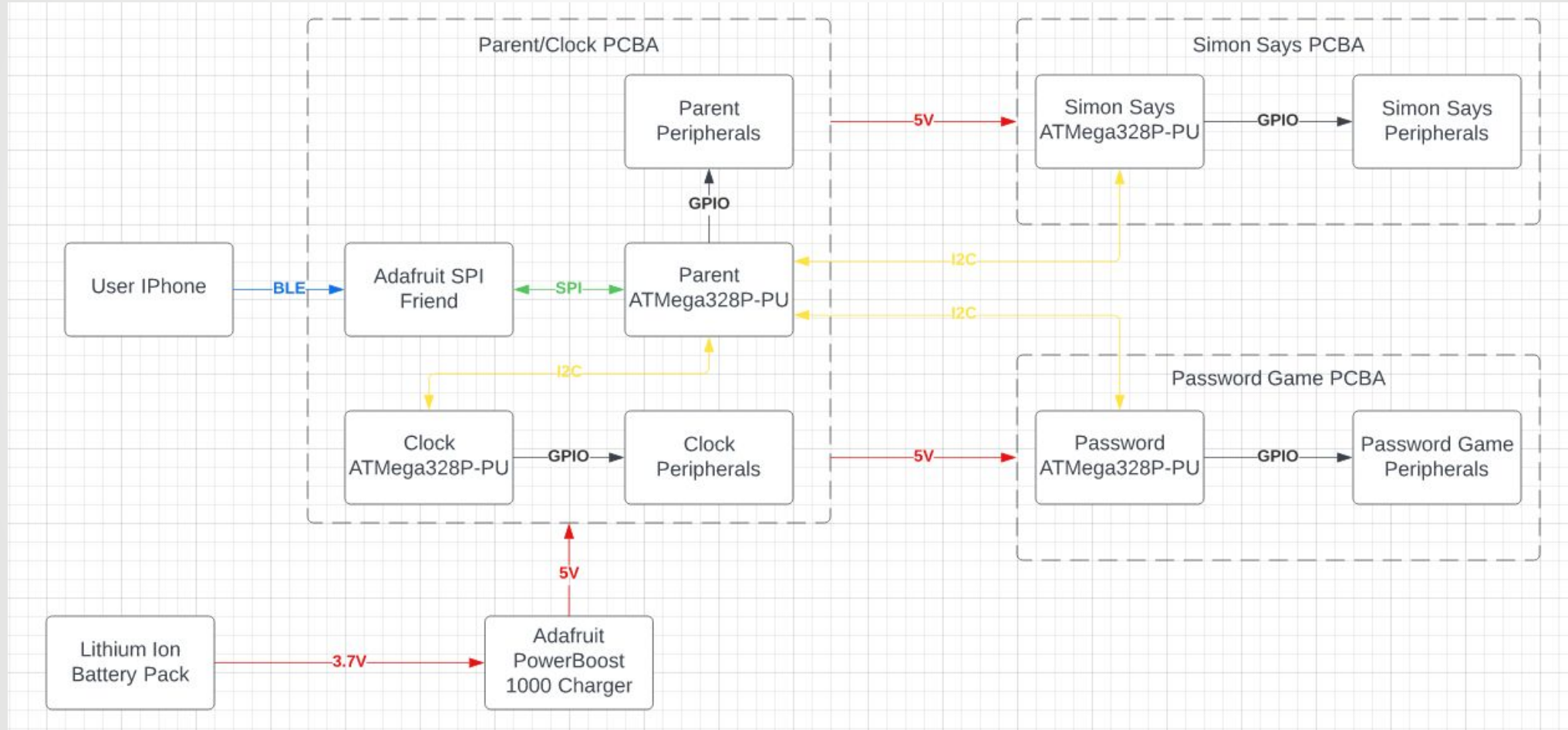
Final Status of Specifications

- ✓ Uses a physical “bomb” with modules installed
- ✓ Randomizes each module each time a new level starts (20+ configurations)
- ✓ Includes difficulty in the form of levels (5+ different levels)
- ✗ Includes at least two regular modules and one needy module
- ✓ Capable of 30 hours of gameplay before recharge
- ✓ Manual will be converted to an app

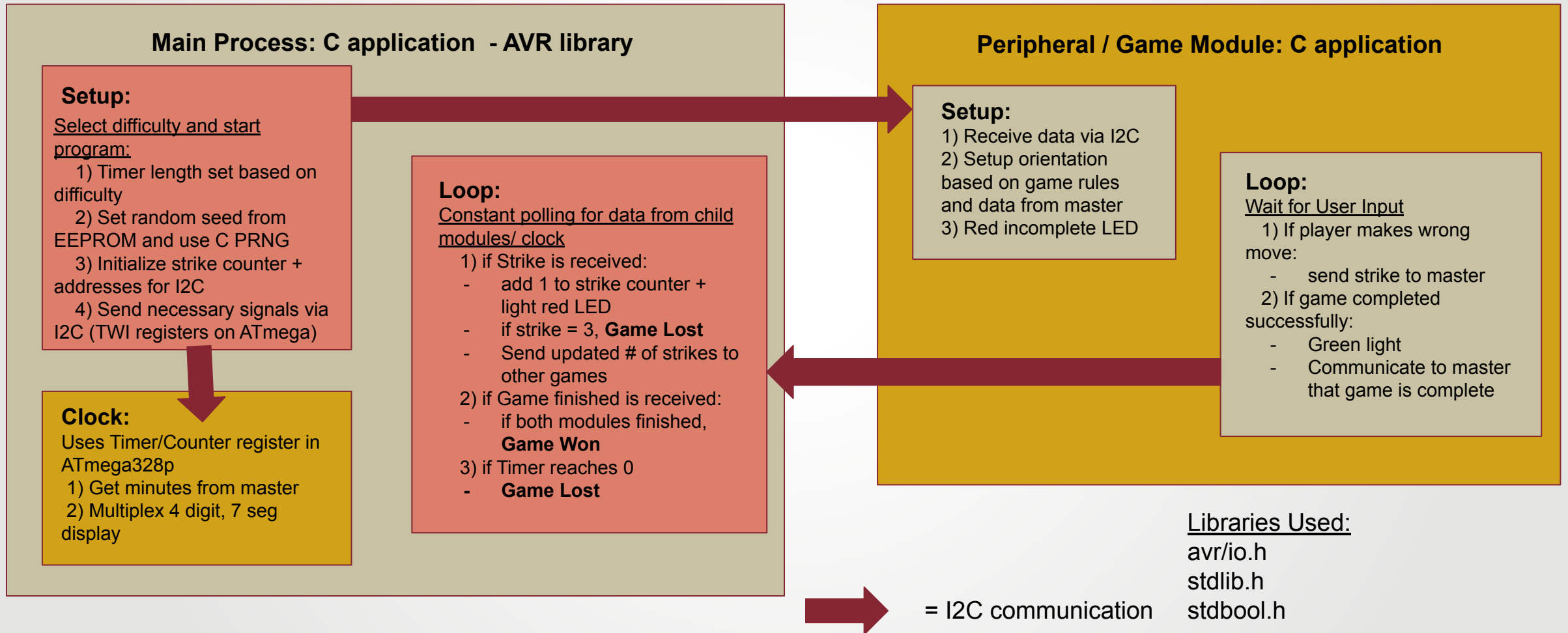
Demo Video



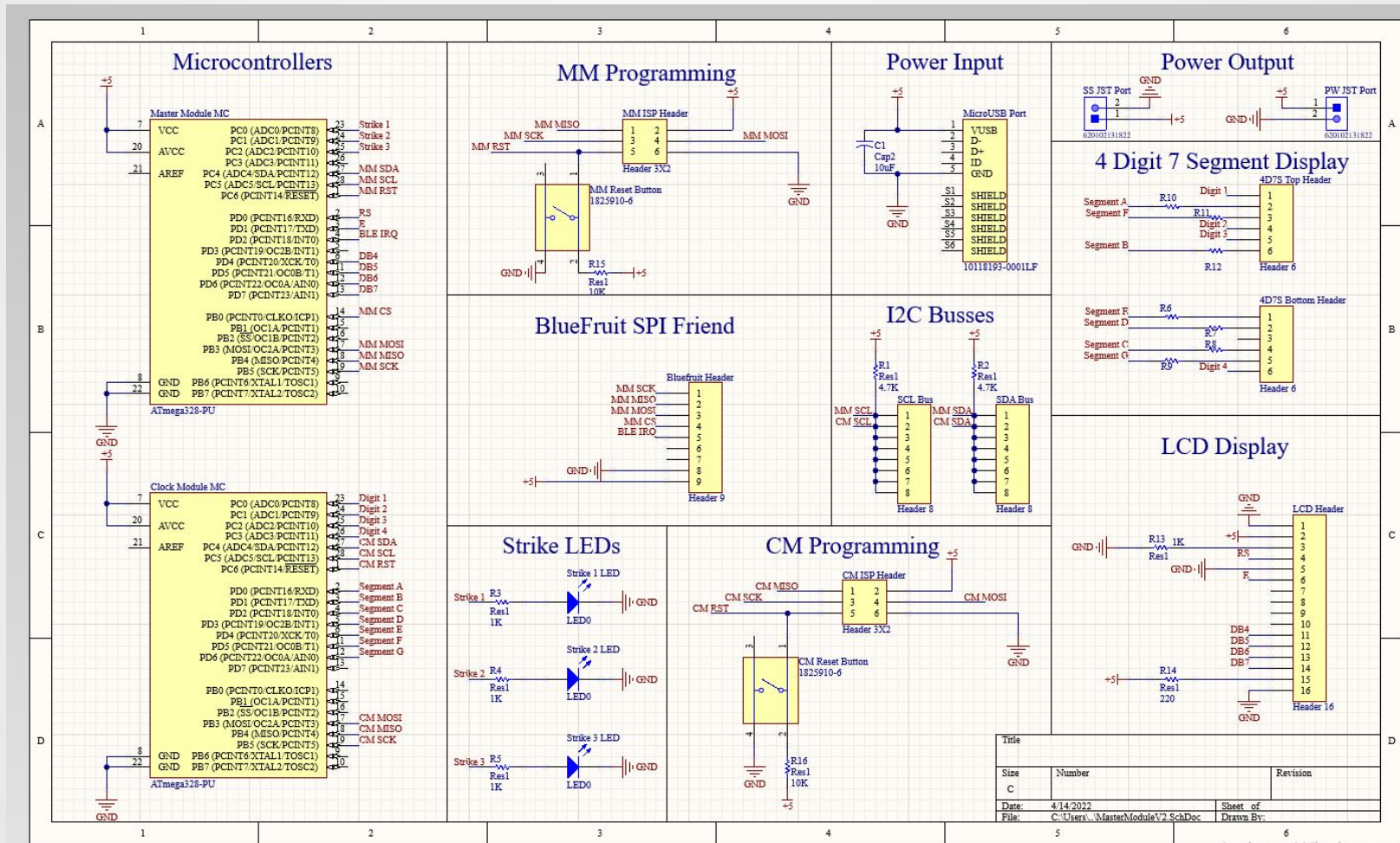
Hardware Block Diagram



Software Block Diagram - Game State



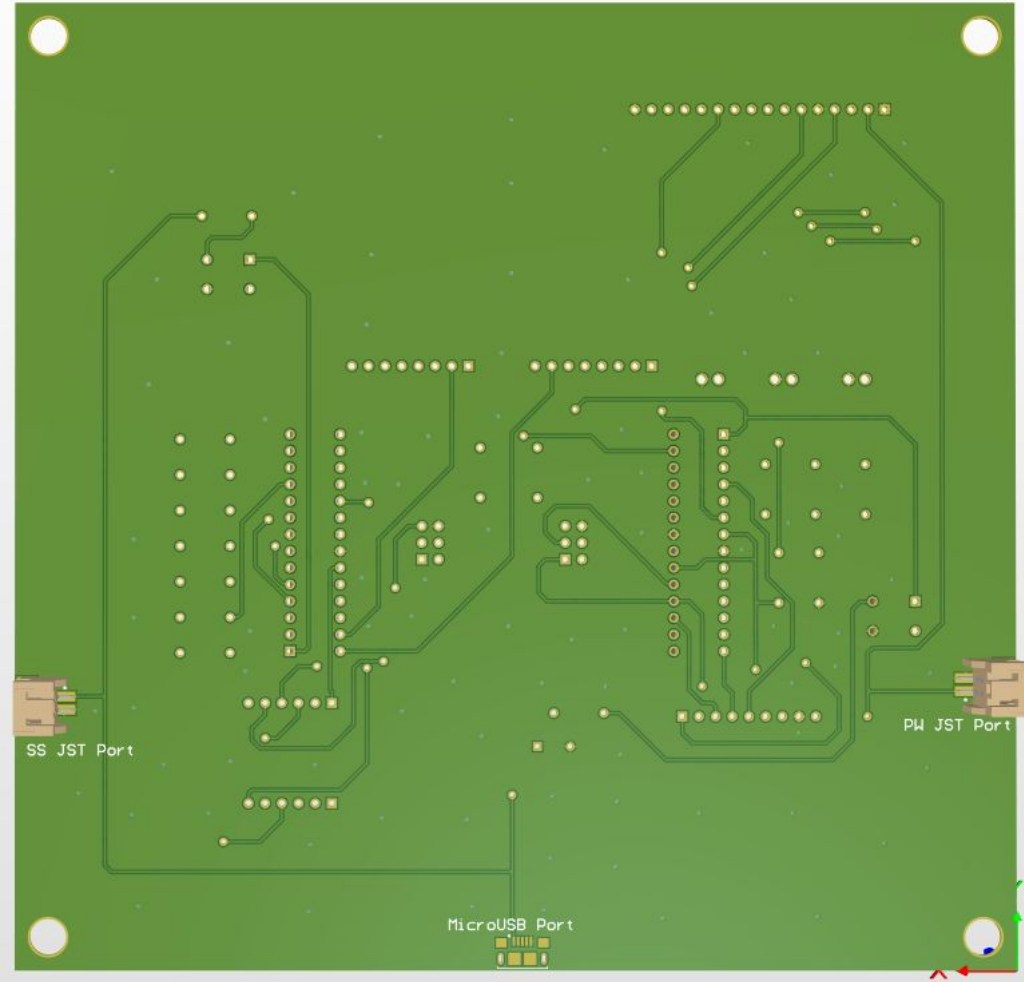
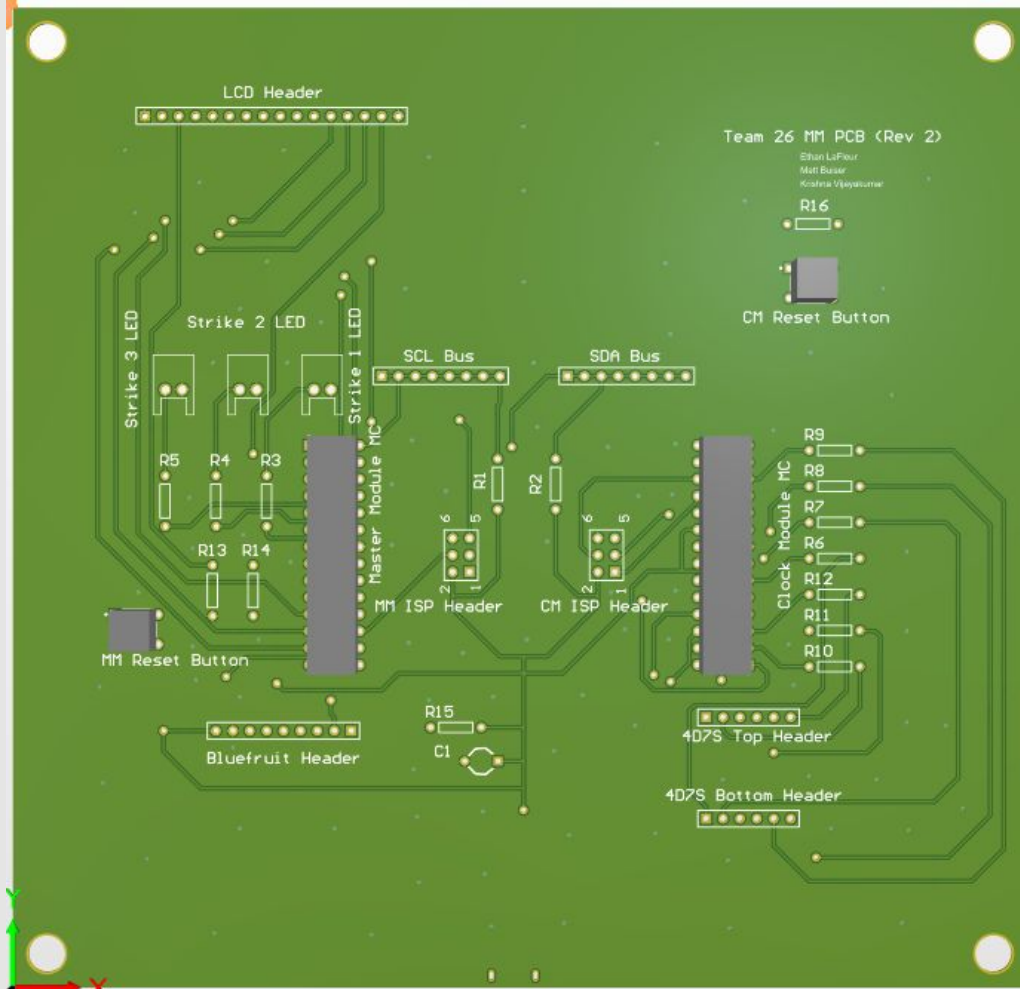
Master Module Schematic



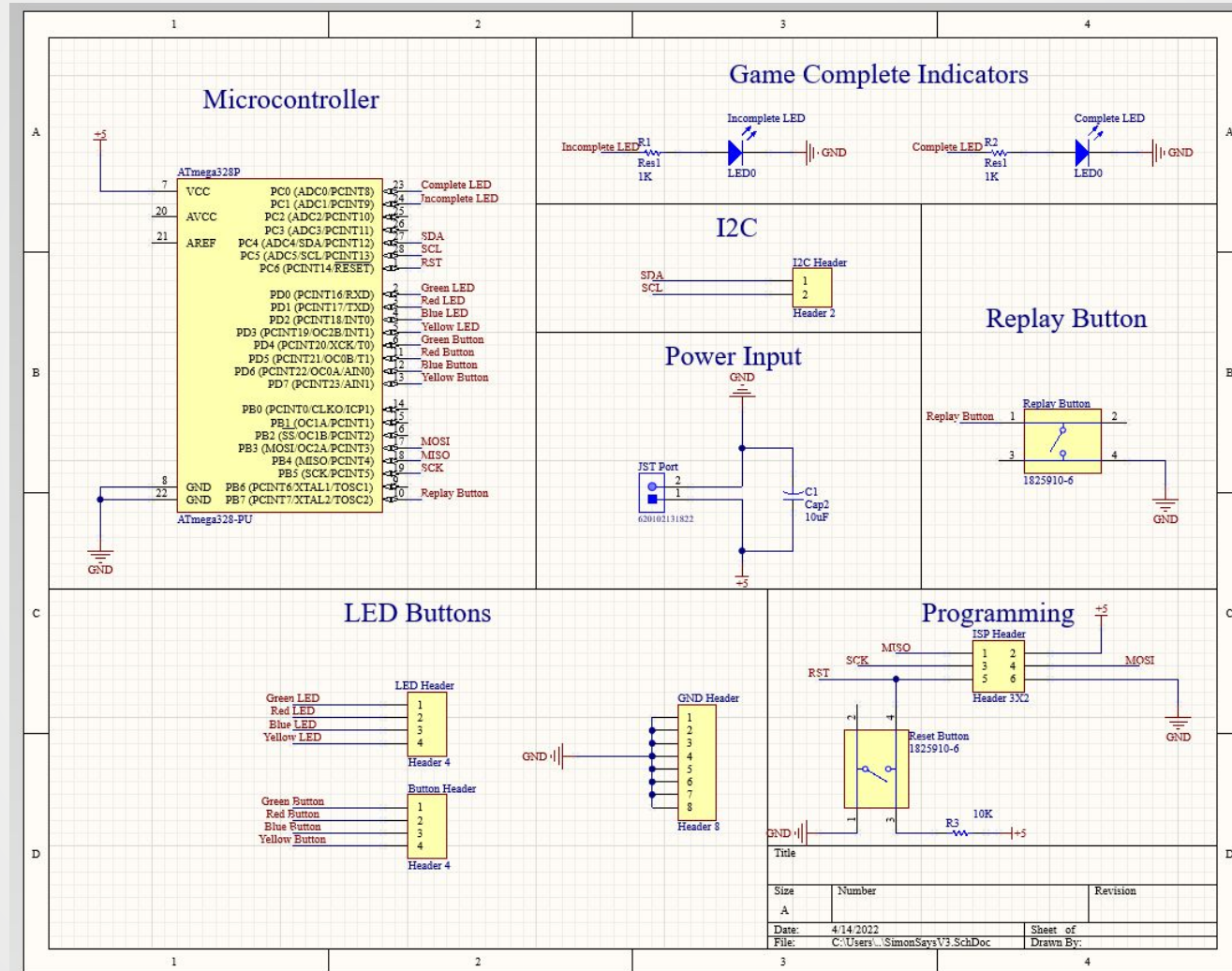
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Activate Windows

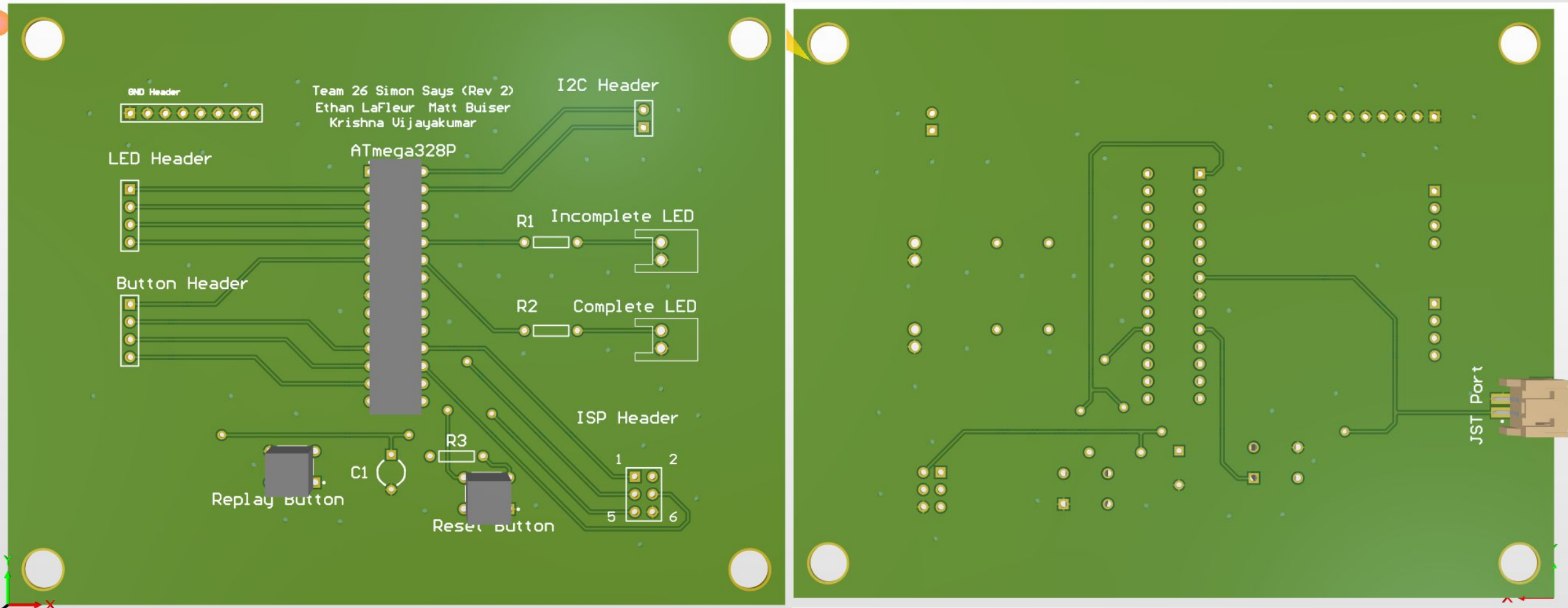
Master Module Custom PCB



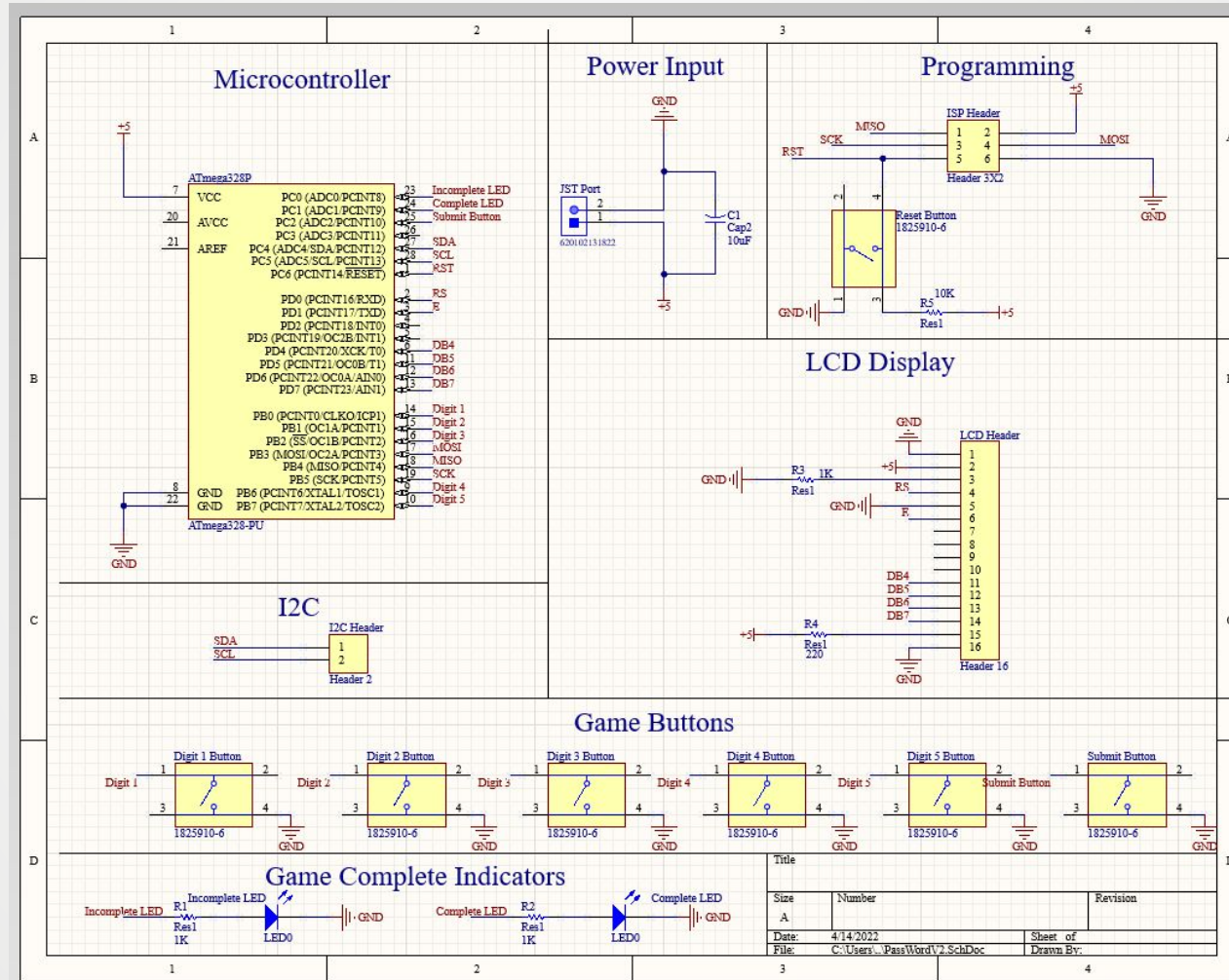
Simon Says Schematic



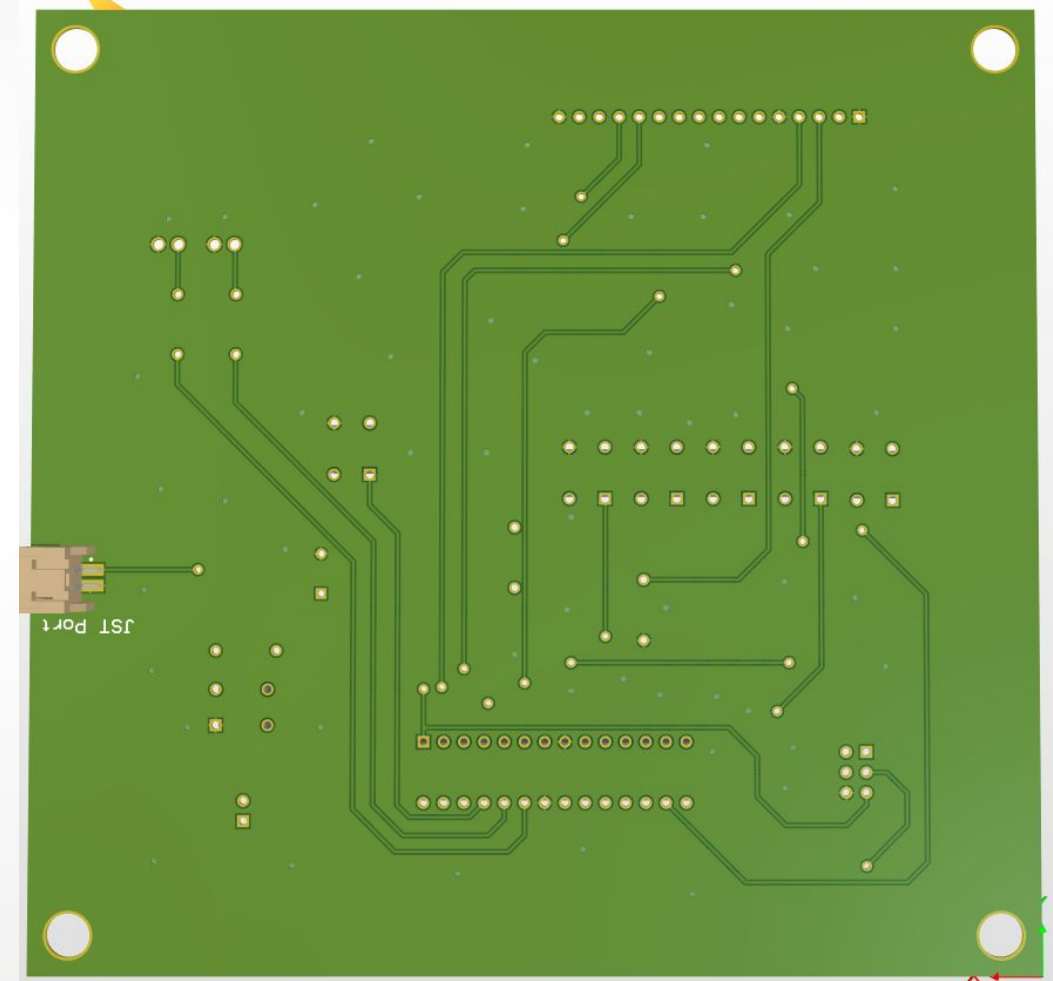
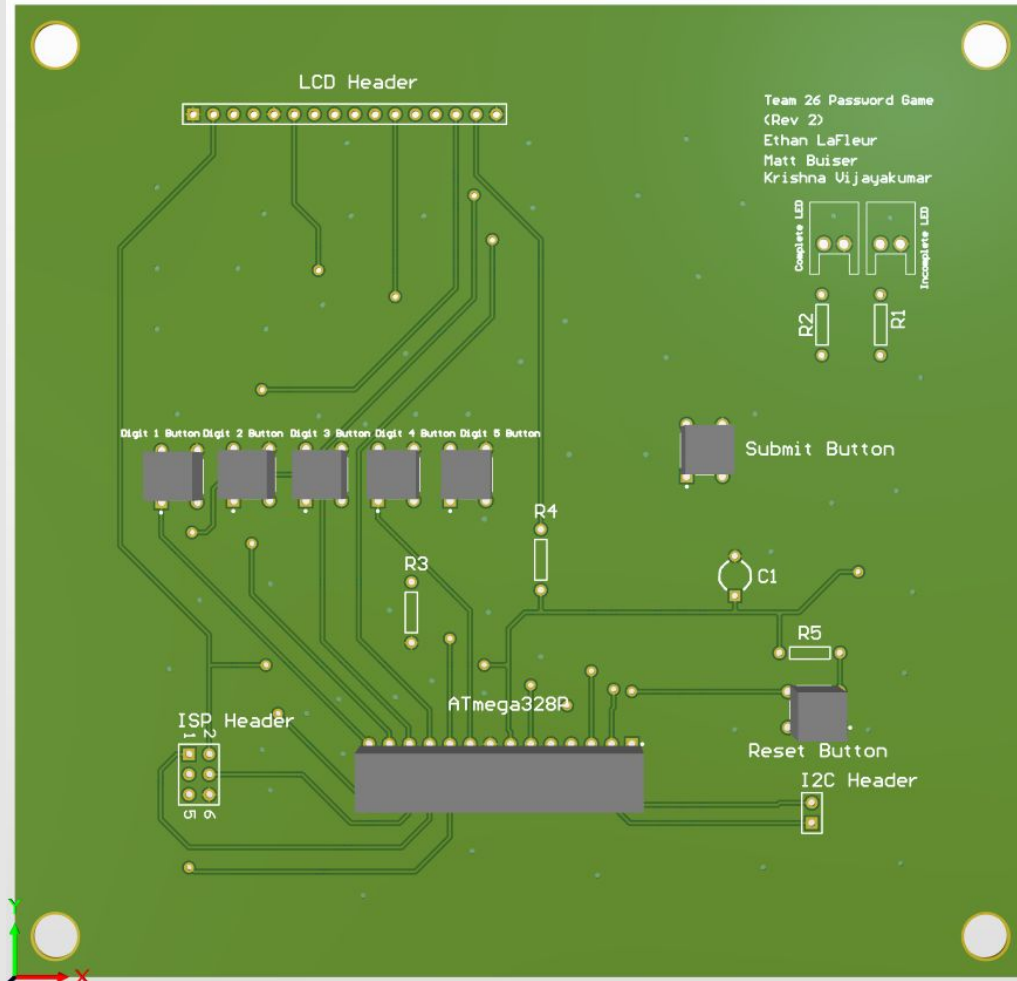
Simon Says Custom PCB



Password Game Schematic

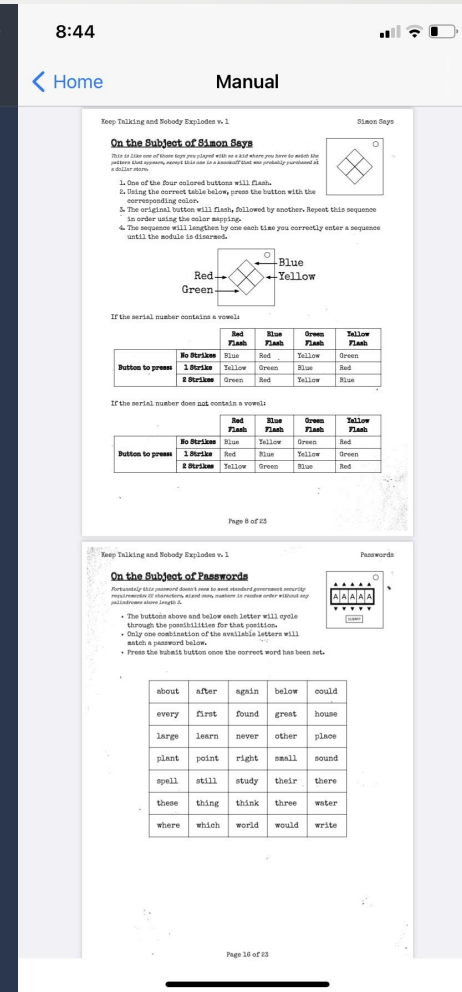
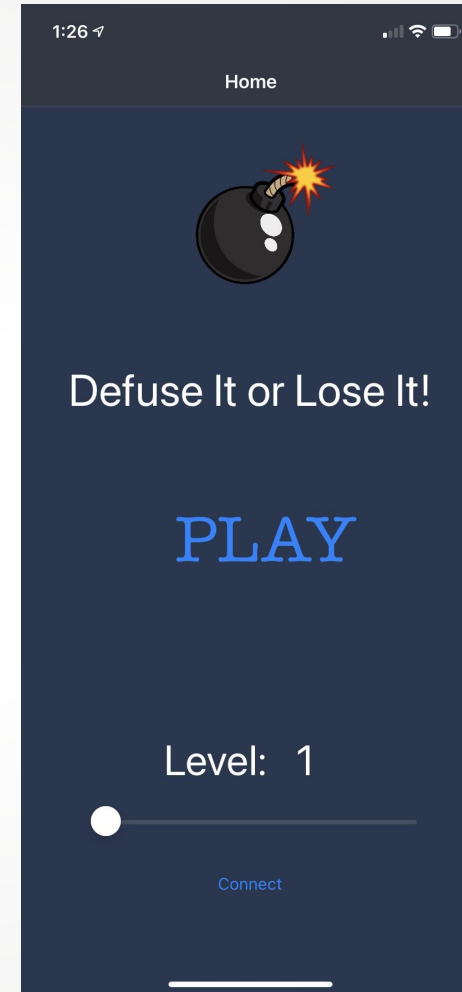


Password Game Custom PCB



BLE Application

- **Basic GUI to host the manual and select difficulty level**
 - An app is more lightweight than a paperback manual
 - slider to select level
 - play button takes user to manual and sends level data
- **IOS app communicates via BLE to the system**



Randomness

- ***rand()* PRNG - C Standard Library**
 - No strong guarantee about quality of #s
- **Seed is stored in non-volatile EEPROM**
- **Uses Linear Congruential Generator to update seed**

○

$$X_{n+1} = (aX_n + c) \bmod m$$

where X is the [sequence](#) of pseudorandom values, and

m , $0 < m$ – the "modulus"

a , $0 < a < m$ – the "multiplier"

c , $0 \leq c < m$ – the "increment"

X_0 , $0 \leq X_0 < m$ – the "seed" or "start value"

- Coefficients chosen such that LCG cycles through $m = 256$ values
- LCG used because noticeable patterns could be seen with simple incrementing of seed

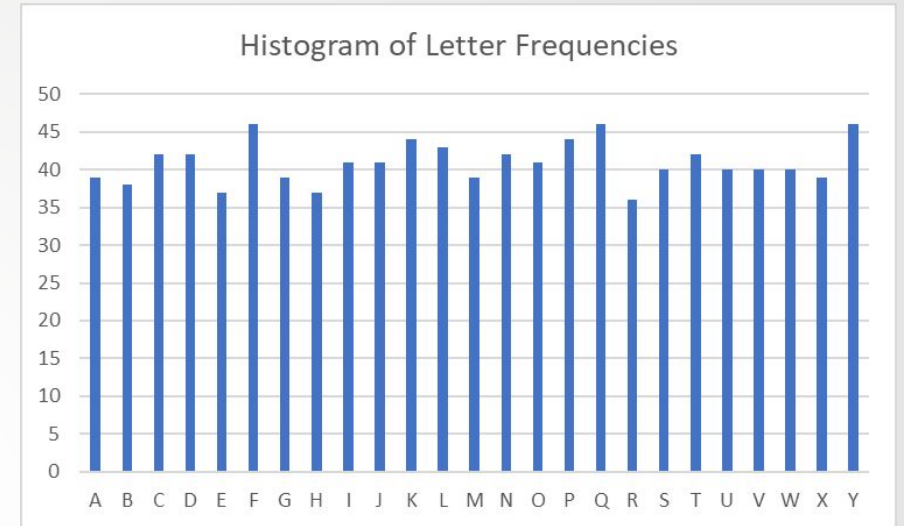
Randomness Analysis

Requirements:

- Each password/ button flash happens equally as often
- Next game configuration not obvious from last few

Properties tested with Serial Number

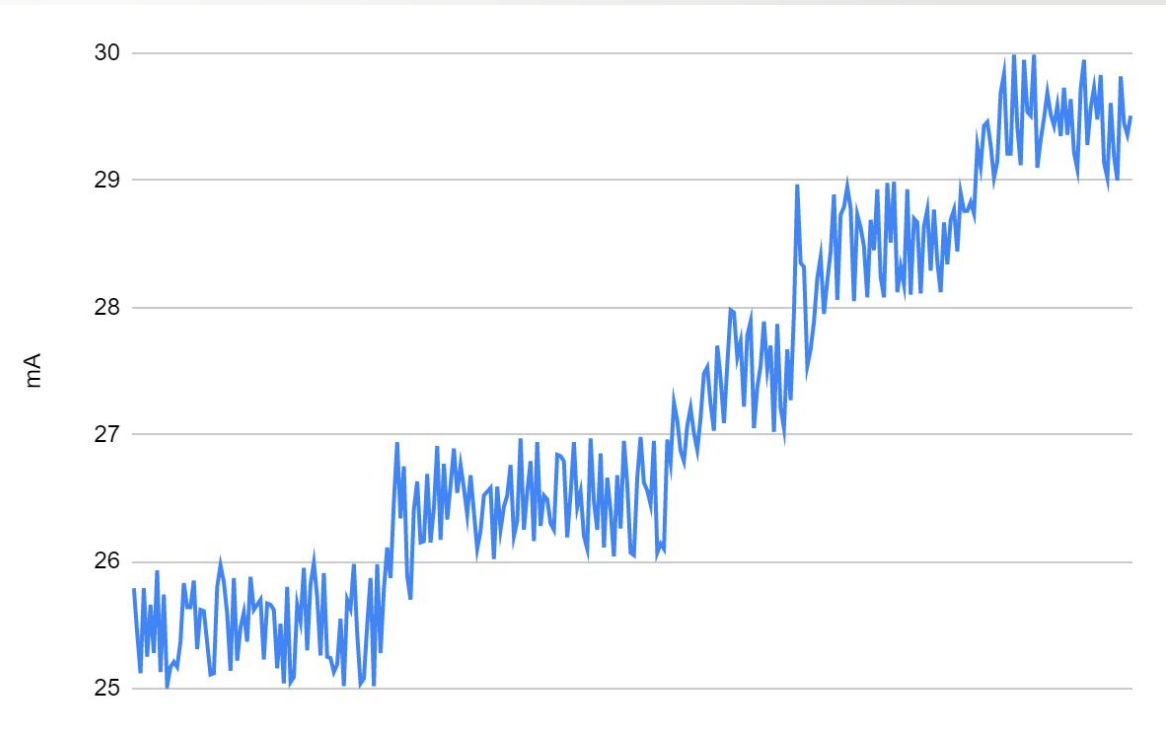
- **Property 1:**
 - 4 letters and 2 numbers per SN, 255 combinations
 - Kolmogorov-Smirnov goodness-of-fit test for uniform distributions → sufficient evidence against uniformity
- **However, distribution is sufficient for casual player**



- **Property 2:**
- **Approximate Shannon Entropy** based on symbol frequencies
 - Measures uncertainty of fluctuations of random variable outcomes
 - Approximately 4.94 bits of entropy
≈ 5.2 bits for 36 characters

Power Report

- **Objective: determine how long battery will last**
 - Battery is a 3.3V, 6600 mAH LIB
- **We can find instantaneous current through the system**
 - Use this to approximate battery life of our system
 - Take samples at each second of multiple playthroughs -> average instantaneous current
- **Average instantaneous current: 27 mA**
 - Battery life of approximately 244 hours



One sample game's instantaneous current draw over the course of a game

Team Member Responsibilities

Ethan LaFleur:

- Team Coordinator: In charge of organizing and running weekly meetings both with the team and also with advisor. Coordinate our presentations/demonstrations with team evaluators.
- Hardware Lead: Determine the hardware that will be used for each module and how to assemble efficiently, as well as designing the custom PCB's.

Krishna Vijayakumar:

- Budget Lead: Ensure budget is spent effectively and keep track of total money spent. Keep track of orders.
- On Board Programmer: Develop software to run based on game/ system specifications

Matt Buiser:

- PCB Lead: Tasked with tracking parts and coordinating with companies, making sure parts will arrive in a timely manner
- Off Board Programmer: Design IOS application and implement bluetooth communication from app to master microcontroller.

Budget

SDP Project Expenditures	Price	Total Cost	Money Left
Lithium Ion Battery Pack	24.5	408.66	91.34
5V 2.5A Switching Power Supply	7.5		
PowerBoost 1000 Charger	19.95		
Shipping	11.7		
4 Arcade Buttons	10		
10 Quick Connect Wire Pairs	4.95		
Quad Alphanumeric Display	13.95		
2 Qwiic JST SH 4 pin to Premium Male Headers Cables	1.9		
Shipping	8.99		
16x2 Standard LCD	10.95		
Shipping	9.1		
Simon Says PCB #1	21		
6 DIP Sockets for Atmegs328p	4.38		
10 JST-PH 2 Pin Right Angle Connectors	9.46		
10 Push Buttons	10.33		
Tax and Shipping	10.5		
Password Game PCB #1	20		
Master Module PCB #1	32		
16x2 Standard LCD	9.95		
2 USB Micro-B Breakout Boards	3		
Shipping	9.92		
Simon Says PCB #1 - accidentally ordered twice	21		
JST Jumper cable + SPI friend + shipping + tax	32.2		
Micro USB + JST Connecters + JST Extender + shipping	41.43		
Final PCB revisions for all modules	60		

Project stayed comfortably under \$500 budget

An aerial photograph of a large crowd of people, mostly wearing red shirts, gathered on a football field. The crowd is arranged in a large, irregular shape that resembles a stylized 'U' or a similar symbol. In the background, the University of Massachusetts Amherst campus is visible, including several buildings and a prominent tall, red brick tower. The sky is blue with some clouds. The text 'Thank you for your time!' is overlaid in white on the field.

Thank you for your time!

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