Team A4 - BeatLock

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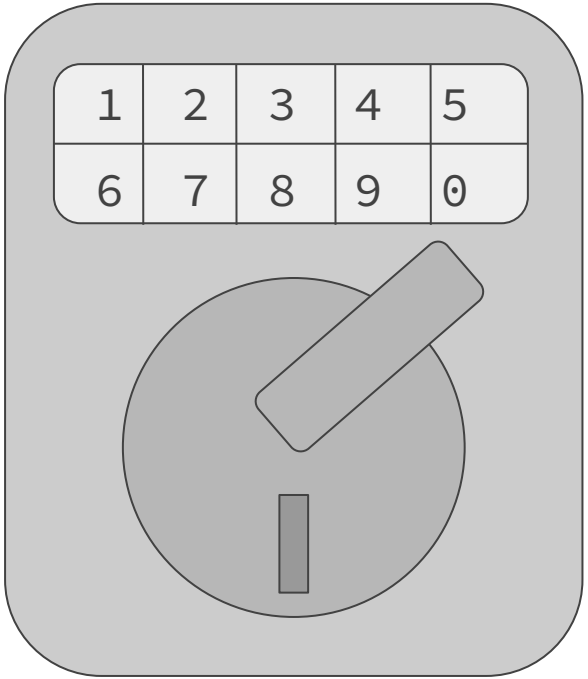
Use Case and Application

Current door unlocking systems have limited security and are boring

Use Case:

- Security
- Fun and engaging
- Durable
- Relatively quick entry time
- Unique key for each user
- Reliability and repeatability



Quantitative Design Requirements

Two-factor authentication via phone app	Communication between the phone, the mat, and the lock via bluetooth
Minimum of 10 dance steps per dance	Correct dance opens door >99% of the time
Ability to choose between >1 song	Speakers should achieve specs 100Hz - 15KHz and ~70dB
Backup PIN	Materials and design must withstand 300 lbs
Differentiate between standing and stepping	Function as a traditional doormat

Security Hardware/Software Manufacturing

Solution Approach

Software

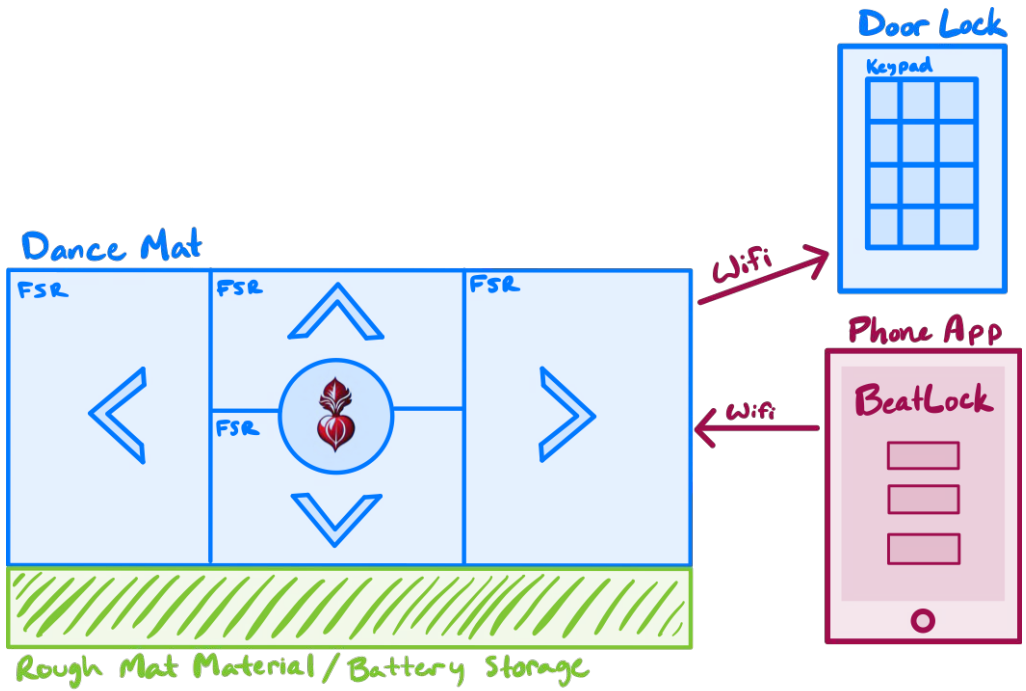
- Arduino IDE for ESP32
- React Native/Expo for App

Hardware

- Custom PCB
- Microcontrollers for Mat and Lock
- Force-Sensing Resistors
- Surface Transducer Speaker
- Capacitive Touch Keypad

Manufacturing

- 3D Printing
- Laser Cutting



Ethical Considerations

Safety and Public Health

- Increased home security
- Physiological and psychological benefits

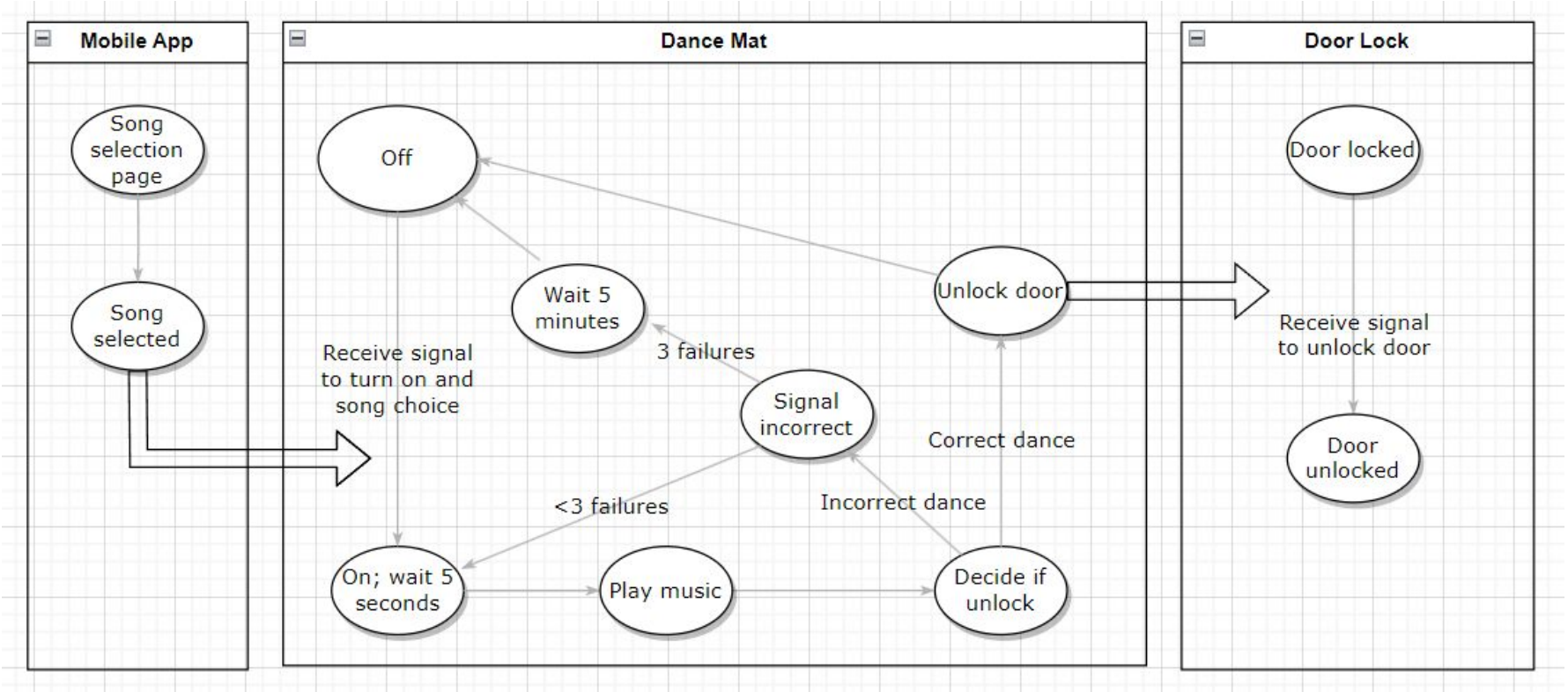
Social

- Product isn't for everyone
- Fun and exciting for young adults

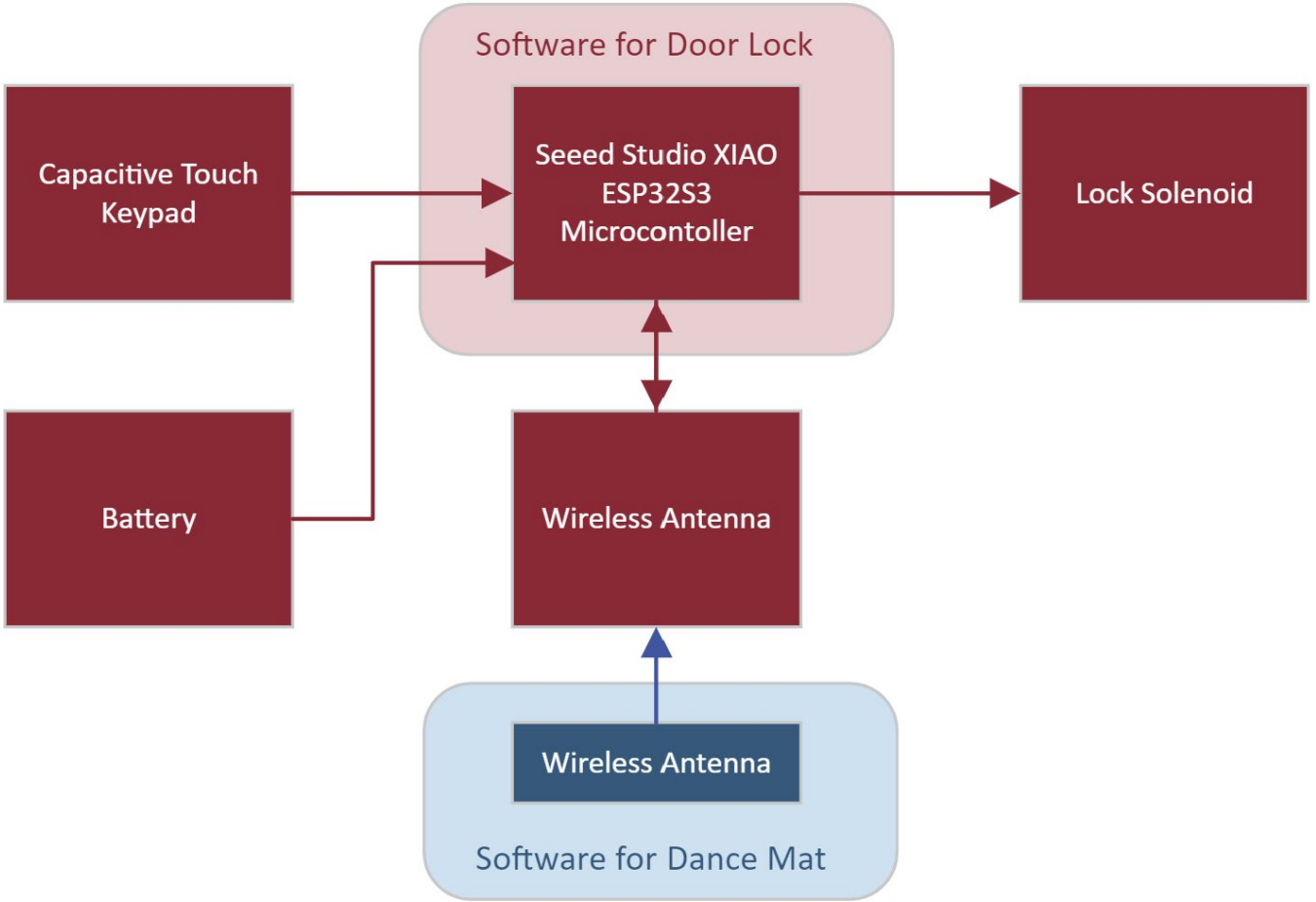
Economic

- Relatively inexpensive (<$150 unit cost target)
- Potential compatibility with existing smart/open source locks

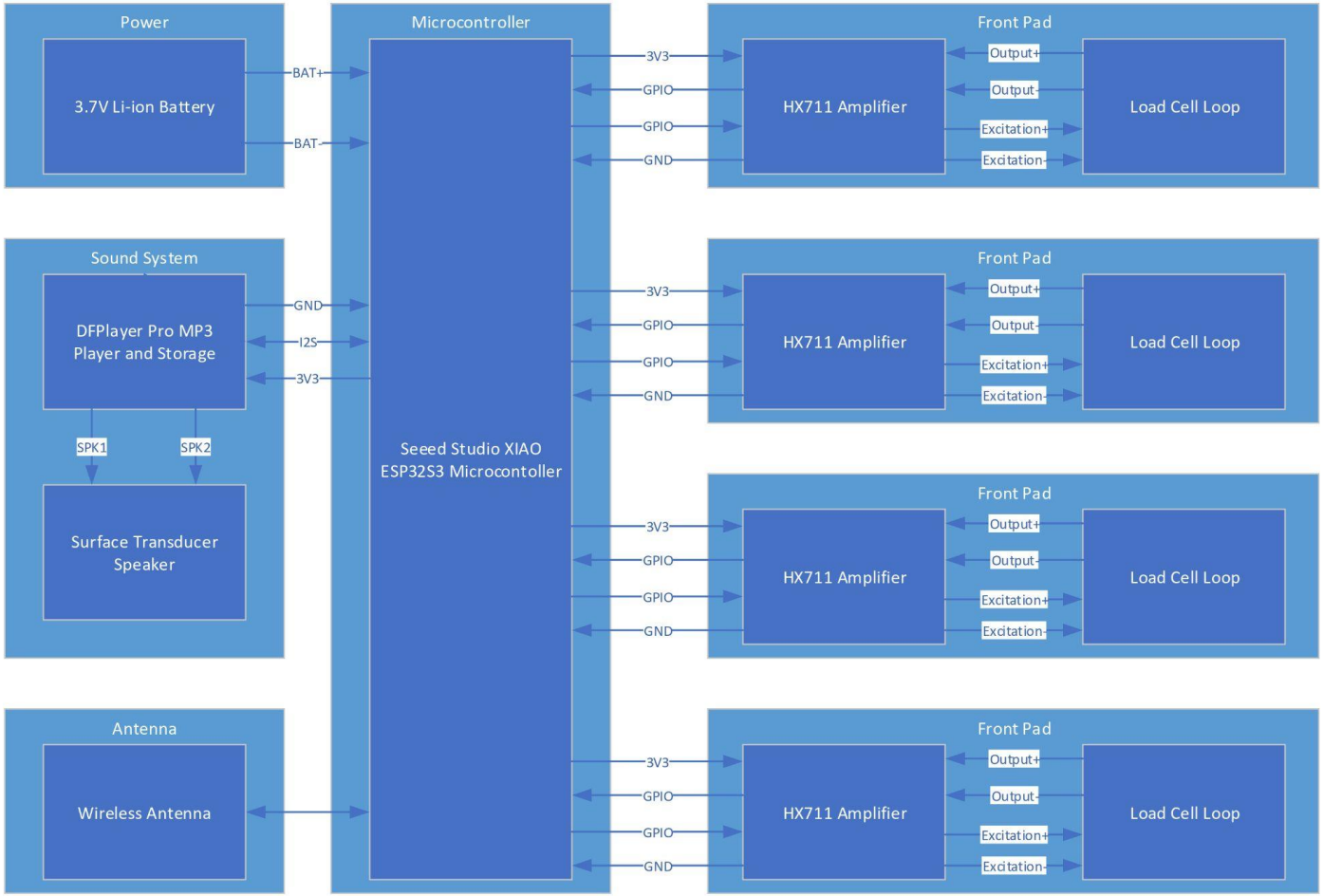
State Diagram



Door Lock Block Diagram



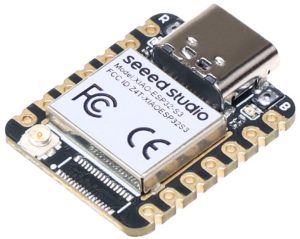
Dance Pad Block Diagram

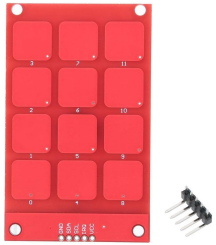
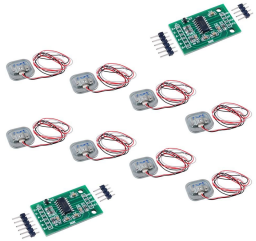
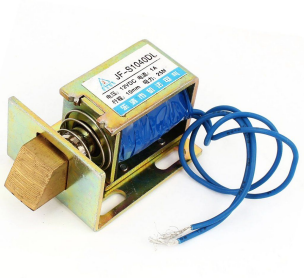


Implementation Plan

Buying

- Microcontrollers, speakers, keypad, FSRs, lock solenoid



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Implementation Plan

Assembling

- Mat, lock, weight sensors

Designing/developing

- PCB, software, app, electronics housing and mat exterior

Testing, Verification, and Metrics

Part Testing

- FSR tuning using a basic step pad prototype
- Speaker testing using a decibel reader and testing different songs for frequency
- Verify functionality of other electronic components

Functional testing

- Use one test dance to verify mat and lock functions

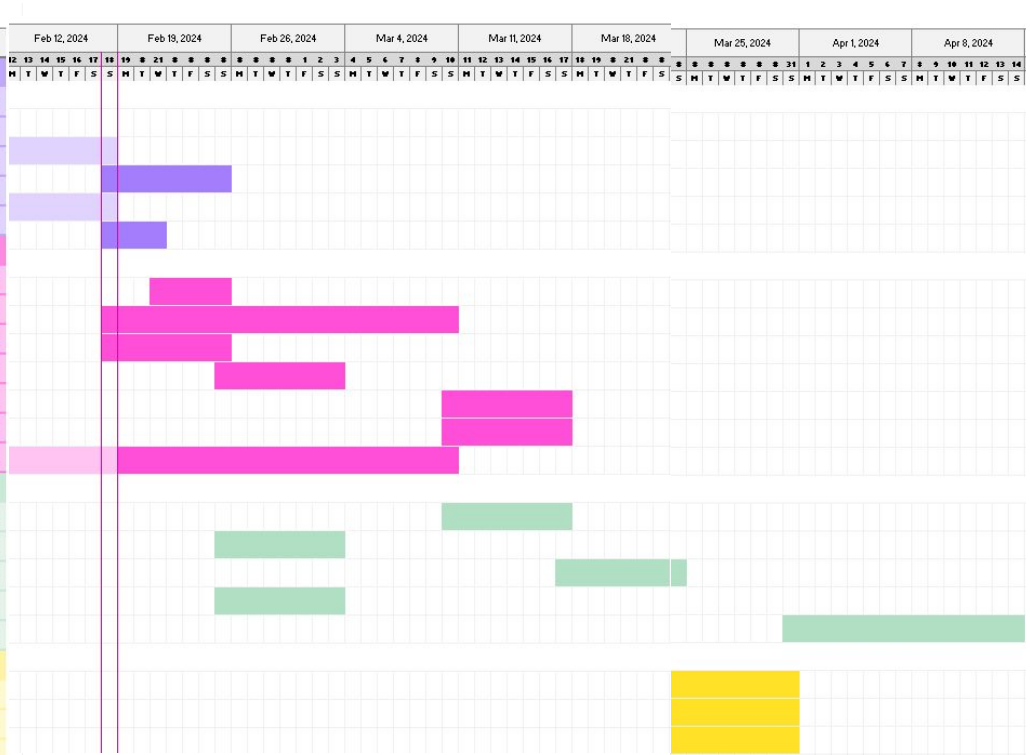
Usability testing

- Get feedback from others (>20 people) about user experience

Reliability testing

- Use stress testing and long-duration testing to find potential issues (>200 test runs)

Project Management

Display week: 1

TASK	ASSIGNED TO	PROGRESS	START	END
Planning and design				
Finish proposal presentation		100%	1/29/2024	2/4/2024
Compile materials list		100%	2/4/2024	2/18/2024
Sensor testing	Brooke	0%	2/18/2024	2/25/2024
Flowcharts	Brooke	100%	2/11/2024	2/18/2024
PCB Schematic	Zoe & Brooke	0%	2/18/2024	2/21/2024
MVP				
PCB Design	Jada & Brooke	0%	2/21/2024	2/25/2024
Firmware	Zoe	0%	2/18/2024	3/10/2024
CAD for mat and lock	Jada & Brooke	0%	2/18/2024	2/25/2024
3D print parts	Brooke	0%	2/25/2024	3/3/2024
Assemble mat electronics	Jada & Brooke	0%	3/10/2024	3/17/2024
Assemble lock electronics	Jada & Brooke	0%	3/10/2024	3/17/2024
Create mobile app	Zoe	30%	2/11/2024	3/10/2024
Final product development				
Add songs	Zoe	0%	3/10/2024	3/17/2024
Finish mat	Brooke & Jada	0%	2/25/2024	3/3/2024
Add security	Zoe	0%	3/17/2024	3/24/2024
Build lock	Brooke & Jada	0%	2/25/2024	3/3/2024
Slack		0%	3/31/2024	4/14/2024
Testing and verification				
Functional testing	Jada	0%	3/24/2024	3/31/2024
Usability testing	Zoe	0%	3/24/2024	3/31/2024
Reliability testing	Brooke	0%	3/24/2024	3/31/2024