

Team A4 - BeatLock

Zoe Rudnick, Brooke Rodriguez, Jada Fink



Use Case and Design Requirements

Two-factor authentication via phone app	Communication between the phone and mat, and the phone and 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 pad	Materials and design must withstand 300 lbs
Differentiate between standing and stepping	Function as a traditional doormat

Security

Hardware/Software

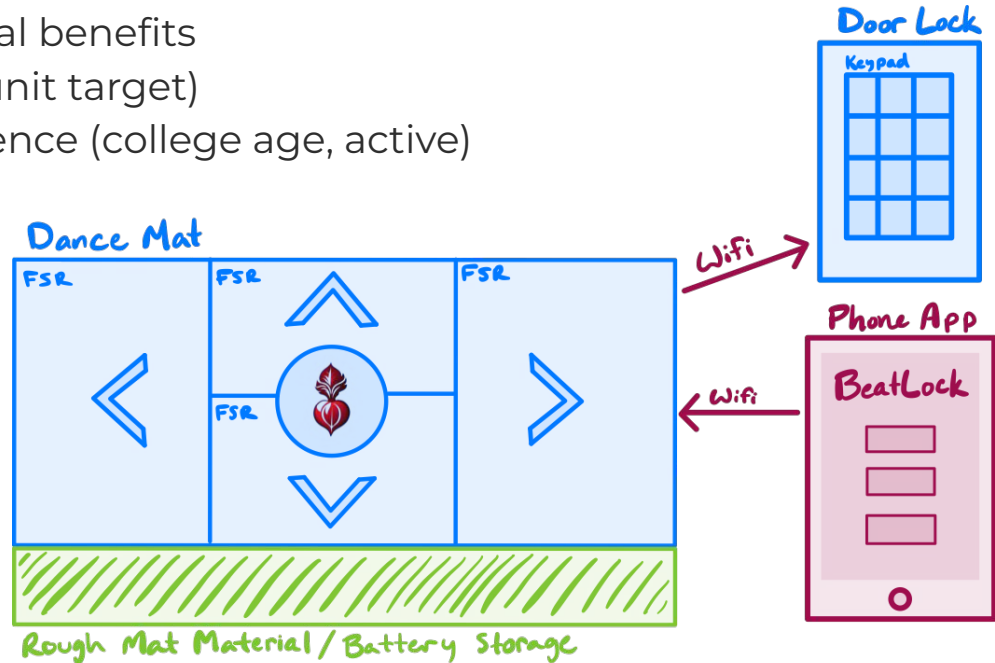
Manufacturing

Solution Approach, Budget, and Ethics

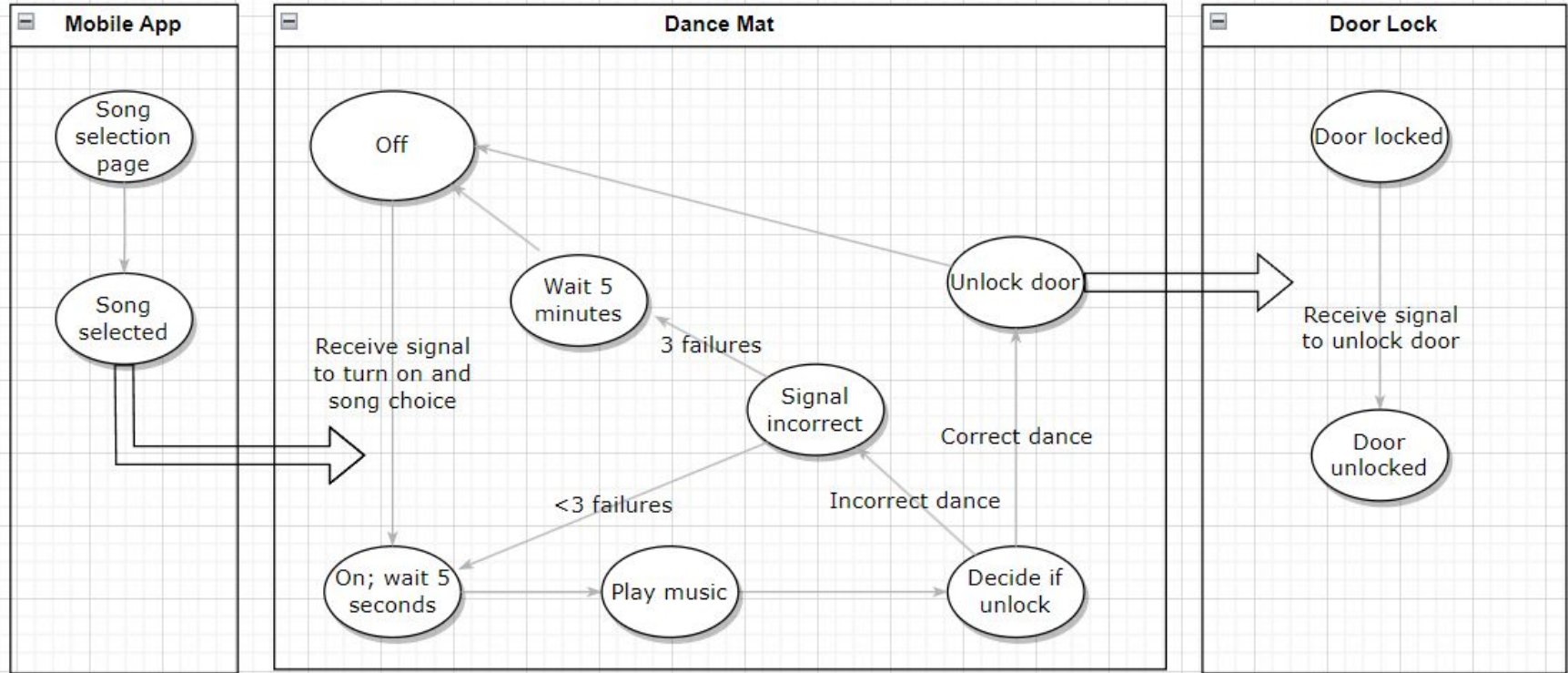
- Increased home security
- Physiological and psychological benefits
- Relatively inexpensive (<\$150/unit target)
- Developing for a specific audience (college age, active)

Current Incurred Costs: **\$303.53**

BeatLock Current Cost: **\$230**

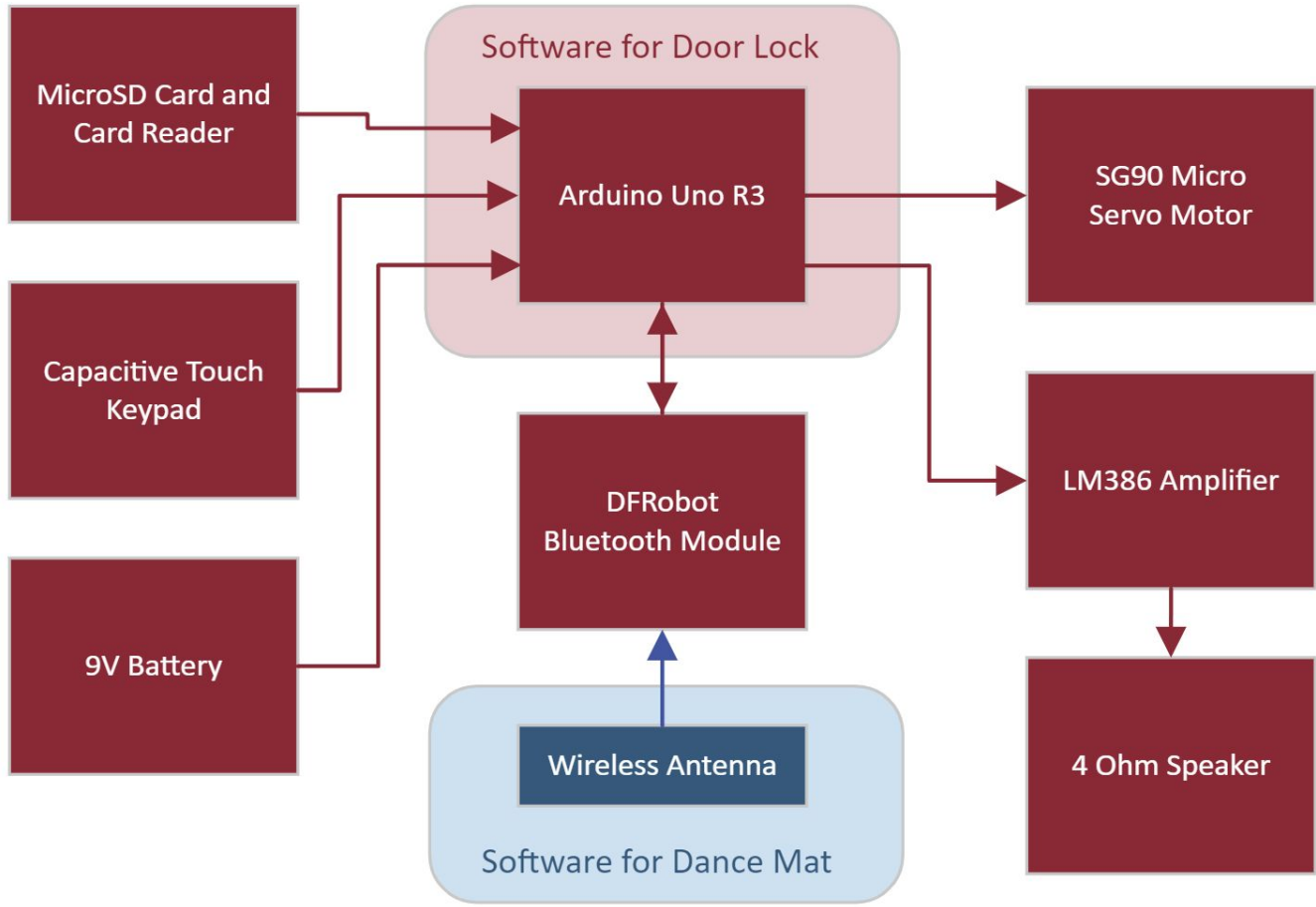


State Diagram

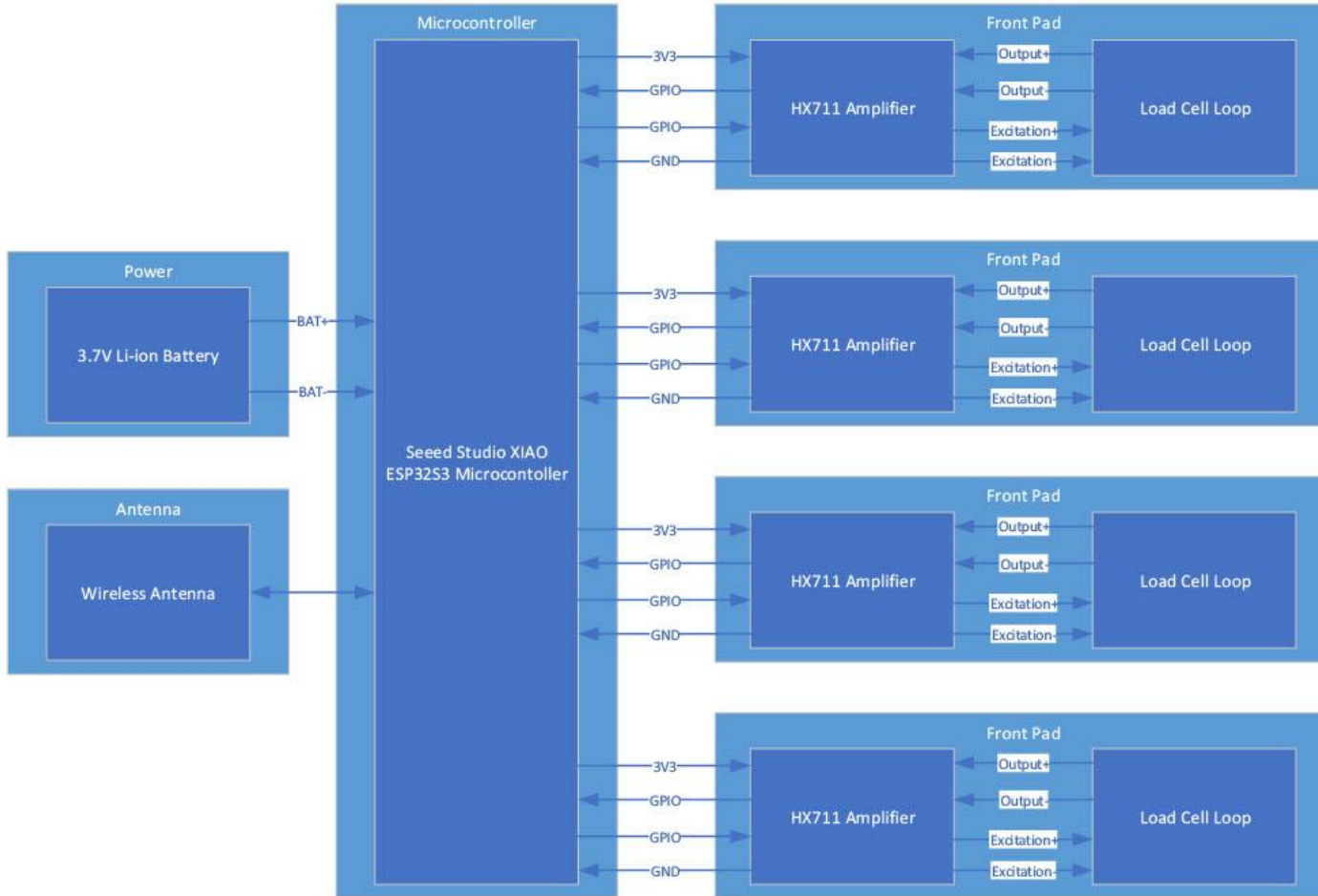


**Backup keypad can directly open door

Door Lock Block Diagram



Dance Pad Block Diagram



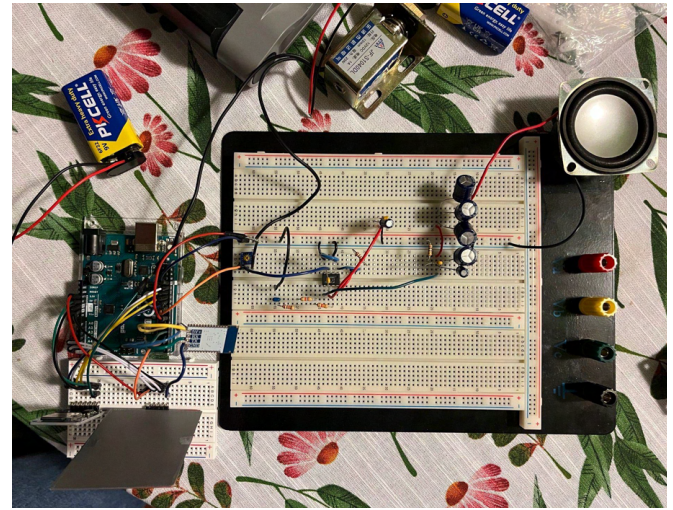
Design Tradeoffs

Lock Design

- Seed to Arduino
 - Impacts costs, size, and complexity
- Solenoid lock to servo motor
 - Impacts power consumption and complexity

Dance Mat Design

- Multiple pad materials
 - Impacts thickness and cost



Verification and Validation of App

Timely connections to mat	6" Away	1' Away	2' Away	4' Away	Standing
Without antenna	5/5	5/5	4/5	2/5	5/5
Antenna added to extend distance, to be tested this week					

Component	Operational (Y/N)
Song selection	✓
BLE connection	✓



Verification and Validation of Lock

Speaker dB Rating (Uncovered)	6" Away	1' Away	2' Away	3' Away
Average (dB)	62.1	59.2	54.3	52.0
Max (dB)	70.3	67.3	62.6	61.5

Component	Operational (Y/N)
Keypad (Uncovered)	✓
Keypad (0.5 mm Thick 3D Printed Cover)	✓
SG90 Micro Servo Motor	✓
MicroSD Card Reader	✓



Verification and Validation of Dance Pad

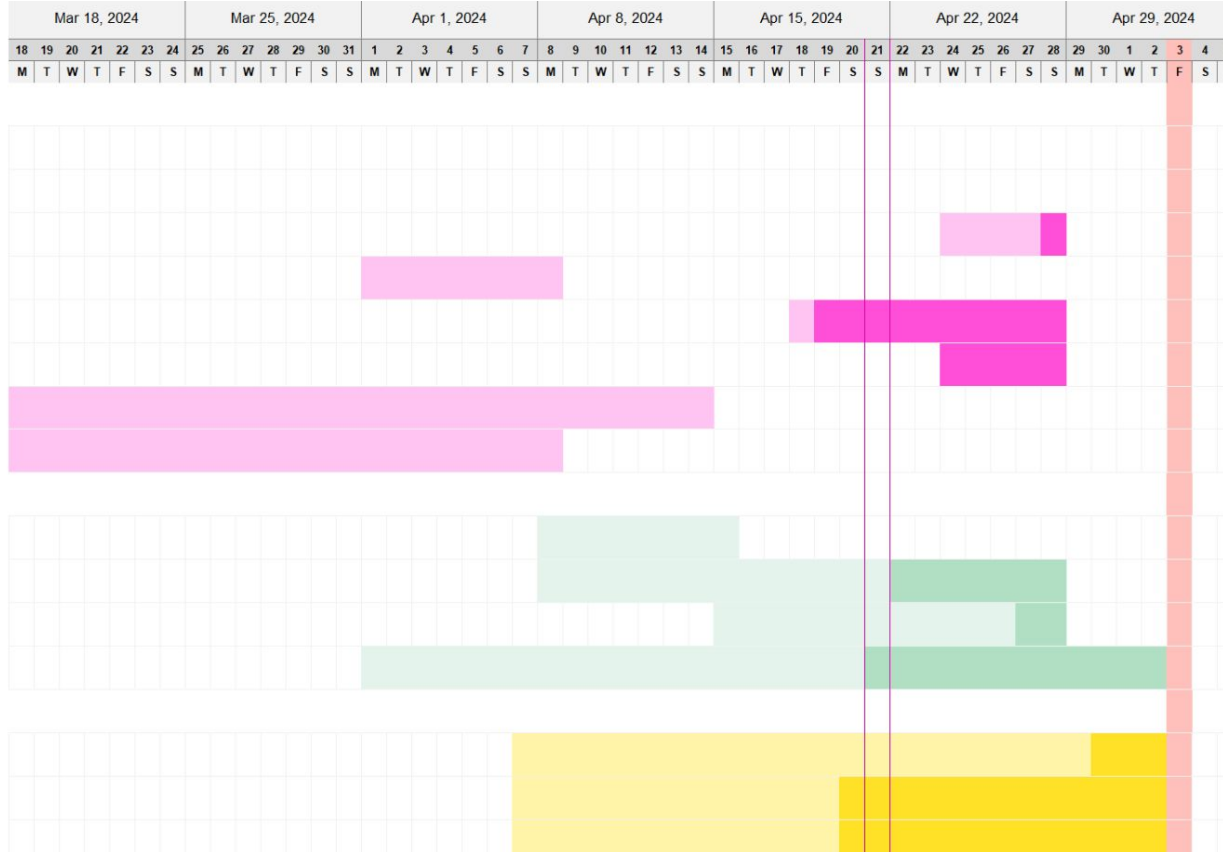
Component	Functionality
Dance Pad Sensors	100% detection on all pads for all weights
LiPo Battery	Functional power and charging
Wooden Pads	Supports weight and jumping, complete flexibility, no waterproofing
Polycarbonate Pads	Supports weight and jumping, complete flexibility, complete waterproofing
Metal Pad Supports	Supports weight and jumping, complete flexibility, unnecessary bulk
Waterproofing and Battery Life Testing	To be tested this week upon completed assembly of the dance pad's case

Project Management

Display week:

8

TASK	ASSIGNED TO	PROGRESS	START	END
MVP				
Firmware	Zoe	80%	2/18/2024	3/10/2024
CAD for mat and lock	Jada & Brooke	100%	2/18/2024	3/3/2024
3D print parts	Brooke	90%	4/24/2024	4/28/2024
Assemble mat electronics	Brooke	100%	4/1/2024	4/8/2024
Replace Lock Mechanism	Jada	10%	4/18/2024	4/28/2024
Laser Cut Lock Housing	Jada	0%	4/24/2024	4/28/2024
Assemble lock electronics	Jada	100%	3/11/2024	4/14/2024
Create mobile app	Zoe	100%	3/11/2024	4/8/2024
Final product development				
Add songs	Zoe	100%	4/8/2024	4/15/2024
Finish mat	Brooke	70%	4/8/2024	4/28/2024
Build lock	Jada	90%	4/15/2024	4/28/2024
Slack		65%	4/1/2024	5/2/2024
Testing and verification				
Functional testing	Jada	90%	4/7/2024	5/2/2024
Usability testing	Zoe	50%	4/7/2024	5/2/2024
Reliability testing	Brooke	50%	4/7/2024	5/2/2024



Approaching the Public Demo...

To be finished:

- Fully integrate subsystems
- Verify demo dance
- Create lock housing
- Improve speaker amplification
- Finish mat case
- User Testing (5+ people)

Plans for Demo Day:

- Show functionality of the complete system
- Demo/teach dance
- No door in plan, servo shows “unlocking”

Lessons Learned: microcontroller architecture, datasheets, videos, forums, time management, sourcing materials

