bRing

Safely bringing joy into your home*

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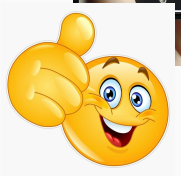
The Problem (Key Motivation)

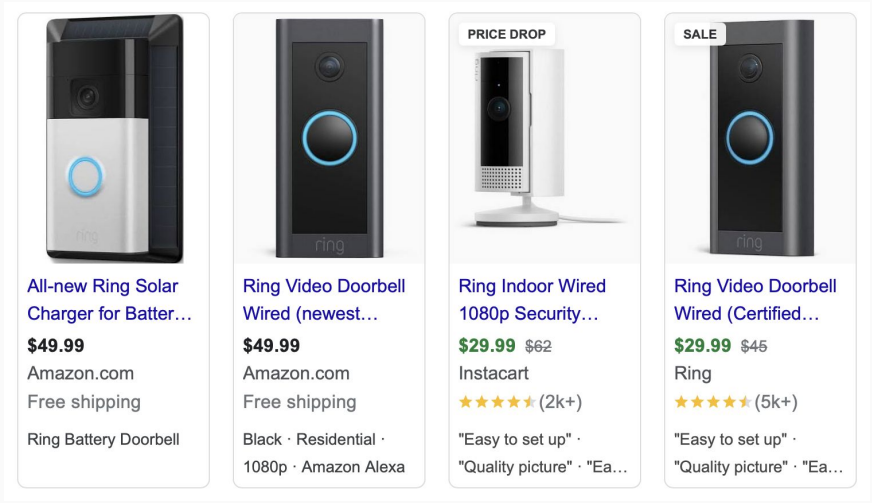
You being a diligent student in ECE 655 💯💯

Your Friend

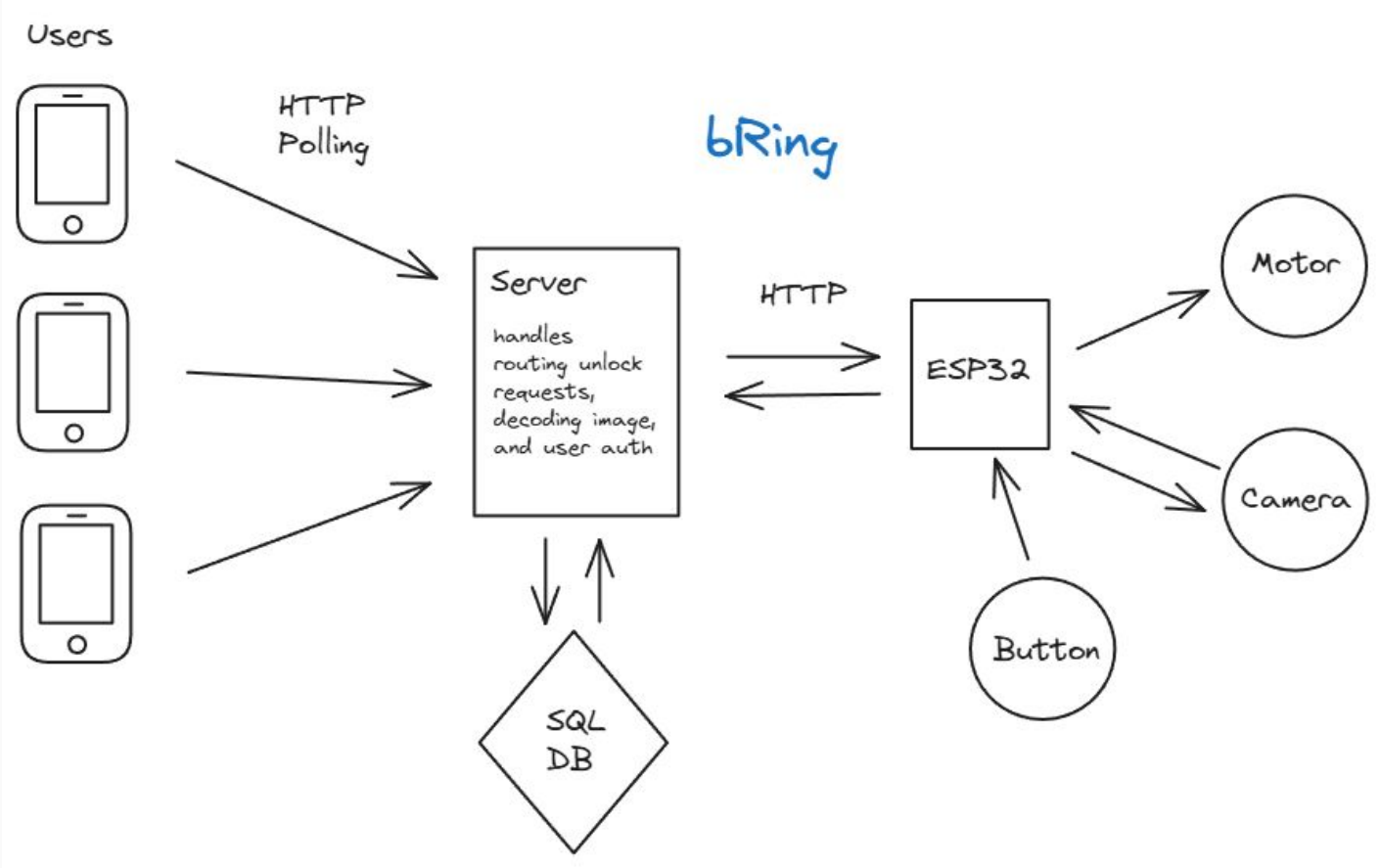


The Problem (Costs & Materials)

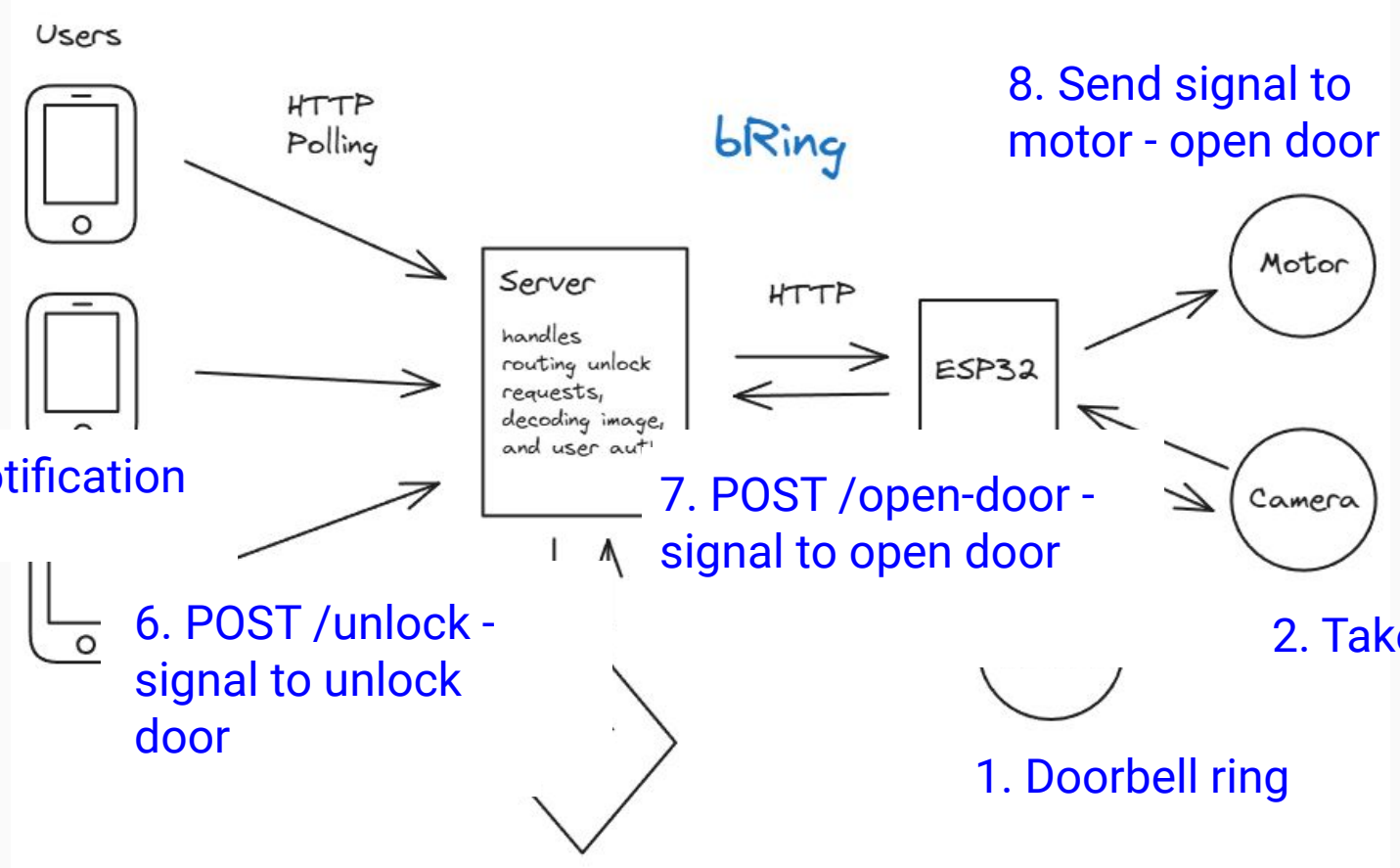
- Lost cost
- Connects to wifi
- Captures image + stores data
  - Before sending it over



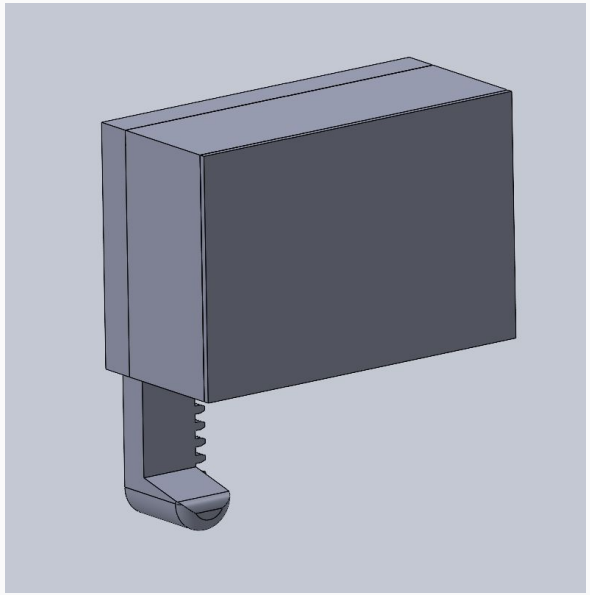
System Design

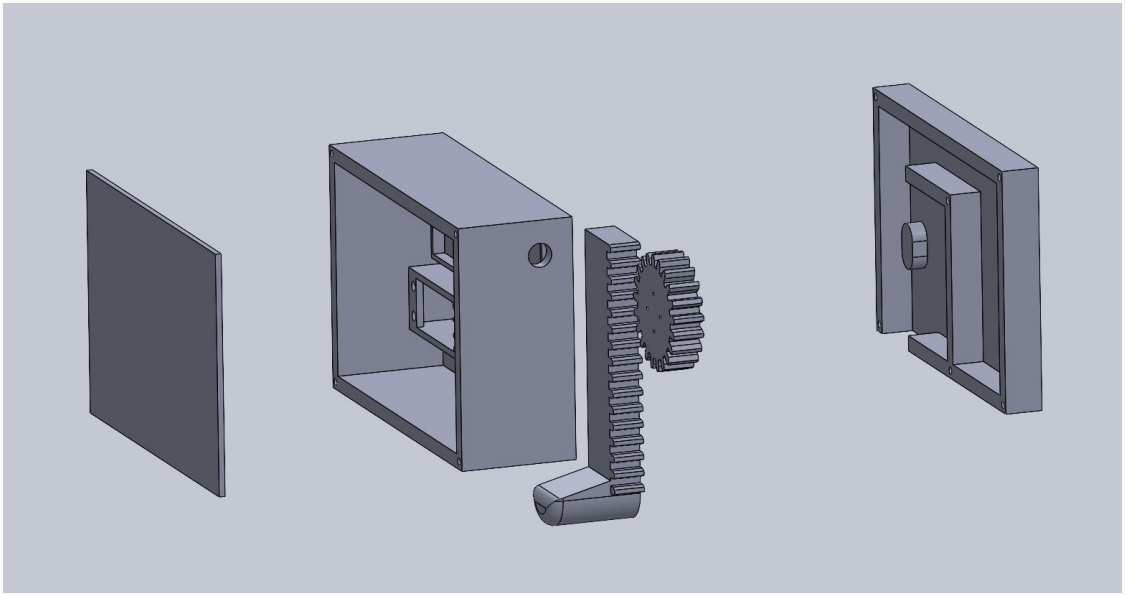


End-to-end Workflow



Applied Techniques / Methods: Hardware

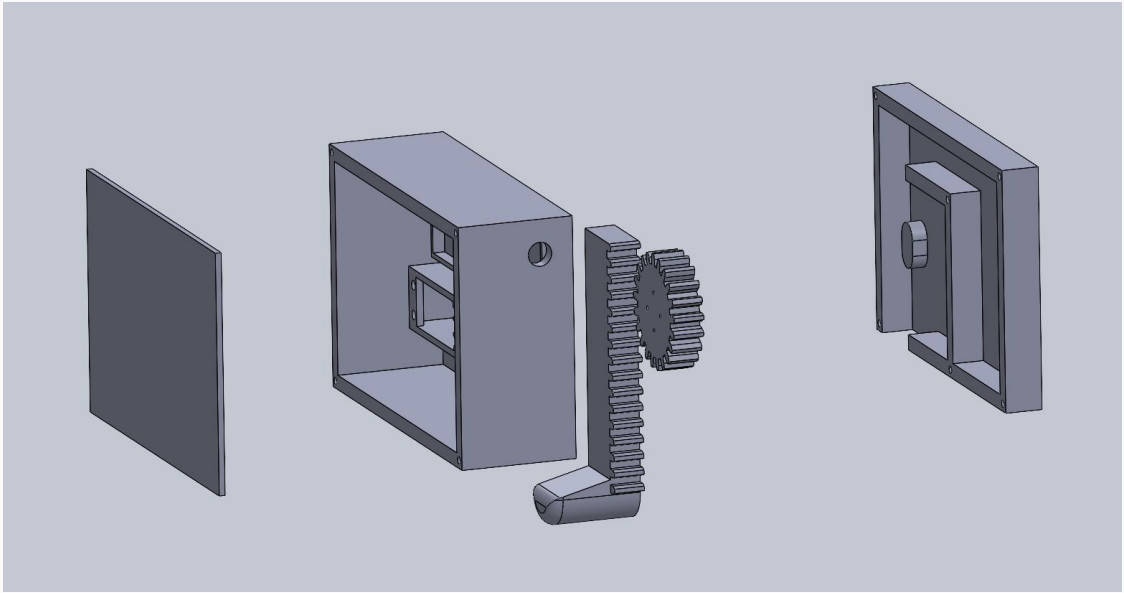




Applied Techniques / Methods: Hardware

- Rack & Pinion
- Component storage

- 3D printed design
- 15kg Servo Motor



Applied Techniques / Methods: Firmware

Lab 1: GPIO, timer, interrupt

- ISR handler for button
- GPIO pins for pin mappings

Lab 2: PWM, OLED, ADC

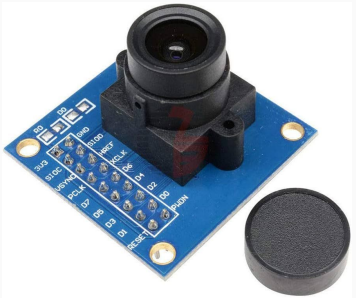
- PWM to control the motor

Lab 4: WiFi & HTTP API

- Connecting to WiFi
- Sending and receiving HTTP GET and POST requests

Extra:

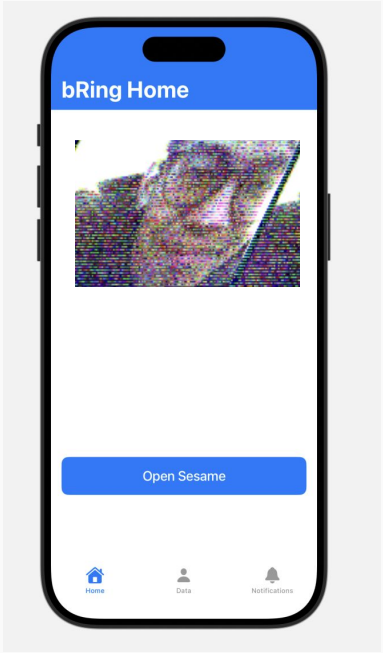
- Controlling O7670 camera



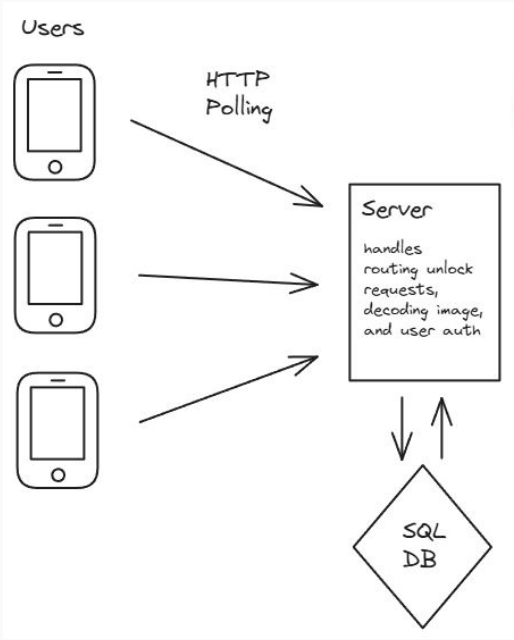
Applied Techniques / Methods: Software

- REST API Server - coordinates door unlocking workflow
- Locking and Concurrent API handling
- Image Conversion: RGB565 -> PNG
- Responsive mobile app built with Swift
- Polling and HTTP requests

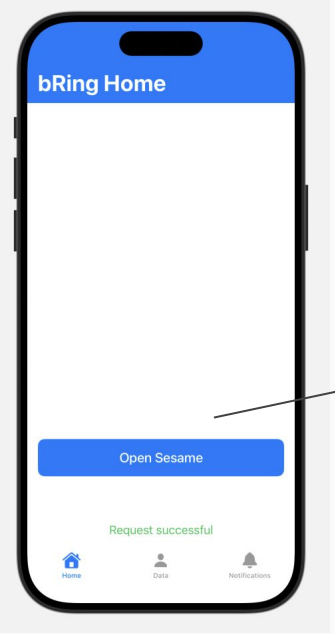
Interfaces: “Receiving request”



- Original: Apple Push Notifications (APN) service
  - Multiple users
  - Distinguish by users
- Alternative: polling
  - one way communication



Interfaces: Software / Backend

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10.197.169.207 - - [03/Dec/2024 15:06:04] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:05] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:06] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:08] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:09] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:10] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:11] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:12] "POST /unlock HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:12] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:13] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:14] "GET /guest-verification HTTP/1.1" 200 -
10.197.169.207 - - [03/Dec/2024 15:06:15] "GET /guest-verification HTTP/1.1" 200 -
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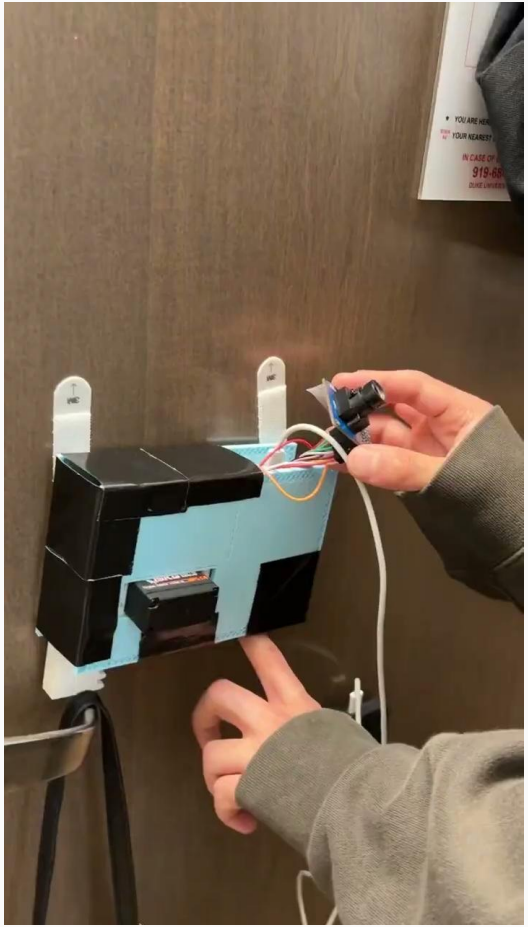
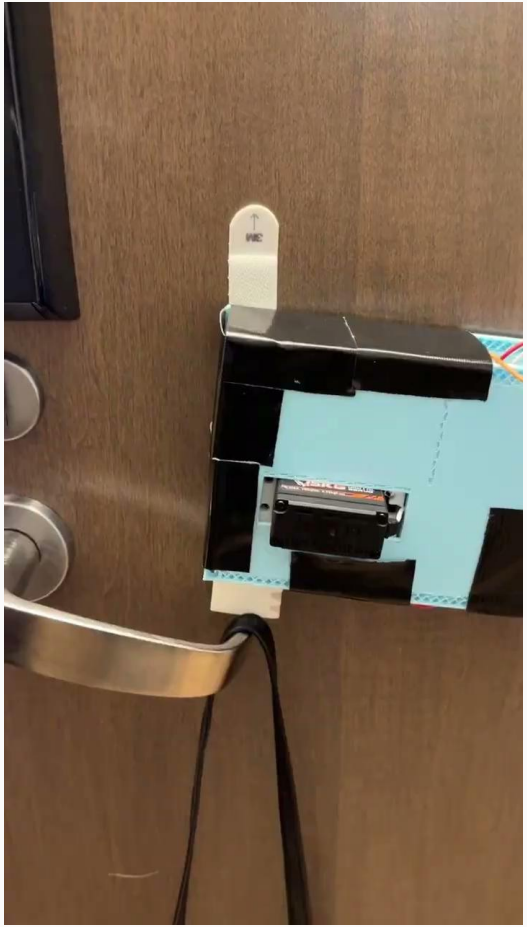
End-to-End Flow

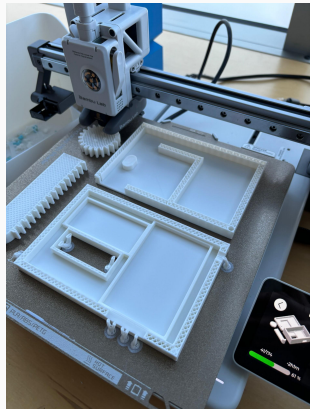


Open Sesame!



Challenges

- Working with ESP32 camera
  - Issues with camera setup -> limited on-board memory, couldn't process higher res images
  - Image conversion - camera recorded in RGB565 with loss of pixels
- iOS mobile app development - many features of iOS gated behind Apple Developer account ($99/year) and had to find workarounds
  - Infrequent polling
  - Local notifications (instead of push)
- Mechanical design of door opener
  - 3D Prints kept failing
  - Weak motor, gear slipping



Possible Next Steps

- Refine definition camera
  - External PSRAM storage
- Implement ML model for facial recognition
- Publish to App Store
- Stronger motor

Questions?