Project Concordia

Smart Home Assistant

Meet the Team

Alex Robles

Nick Pellegrin

Logan Geivet

Peter Lototsky

Jack Newman

Project Overview

The Problem

- Too many proprietary smart home devices
- Most ecosystems are difficult to integrate and not-cross platform

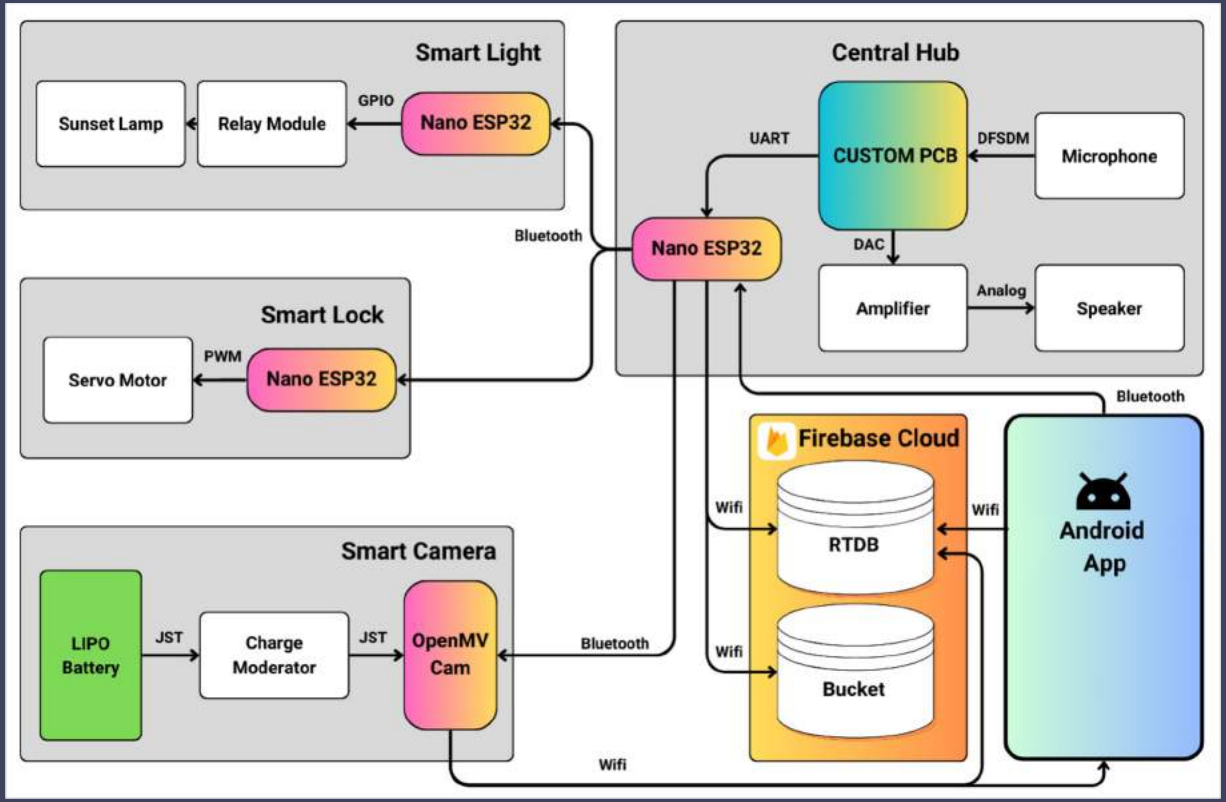
The Solution

- Build an open-source smart home ecosystem
- Allow for easy integration of open-source peripheral devices

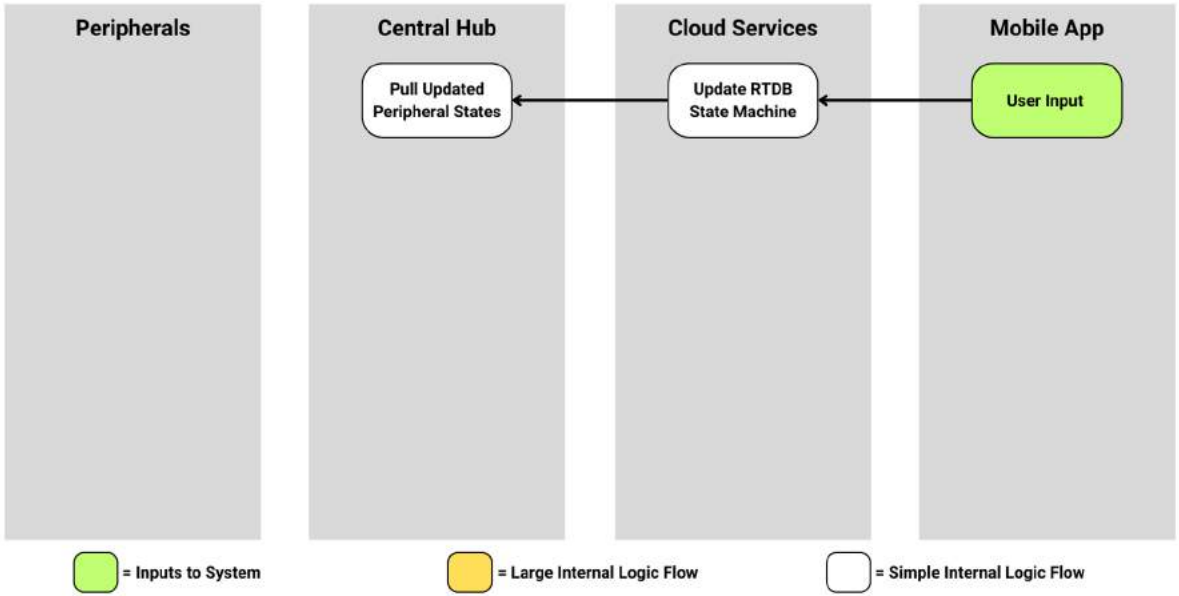
Our Project

- A central Hub with three peripherals:
  - Smart Camera
  - Smart Lock
  - Smart Light
- A cloud backend for integration and easy to use mobile app

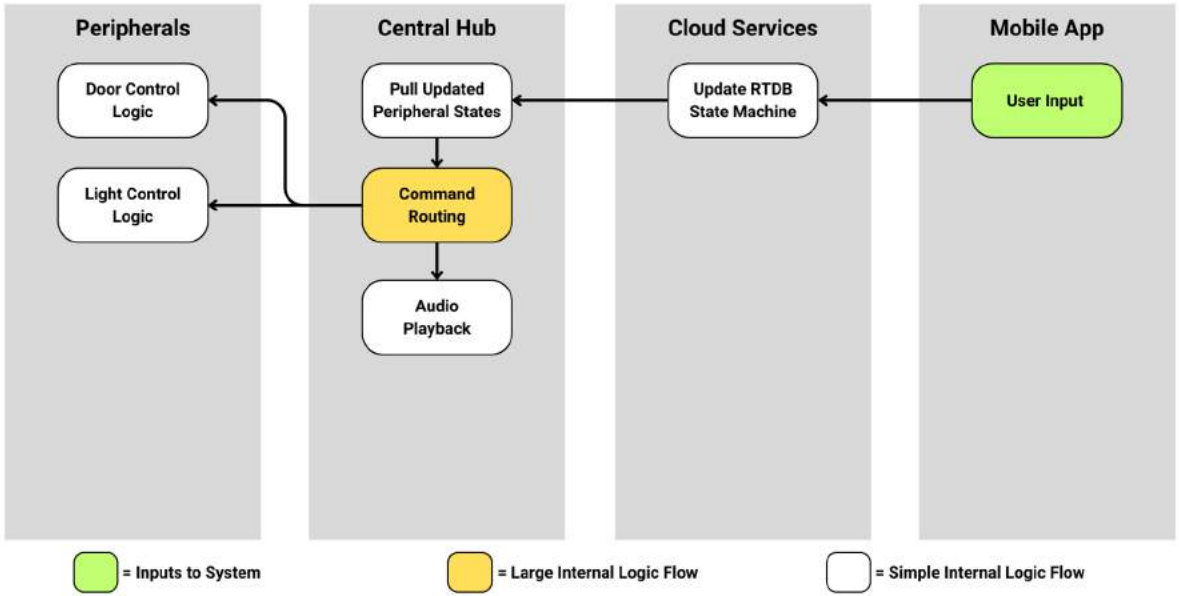
Full Block Diagram



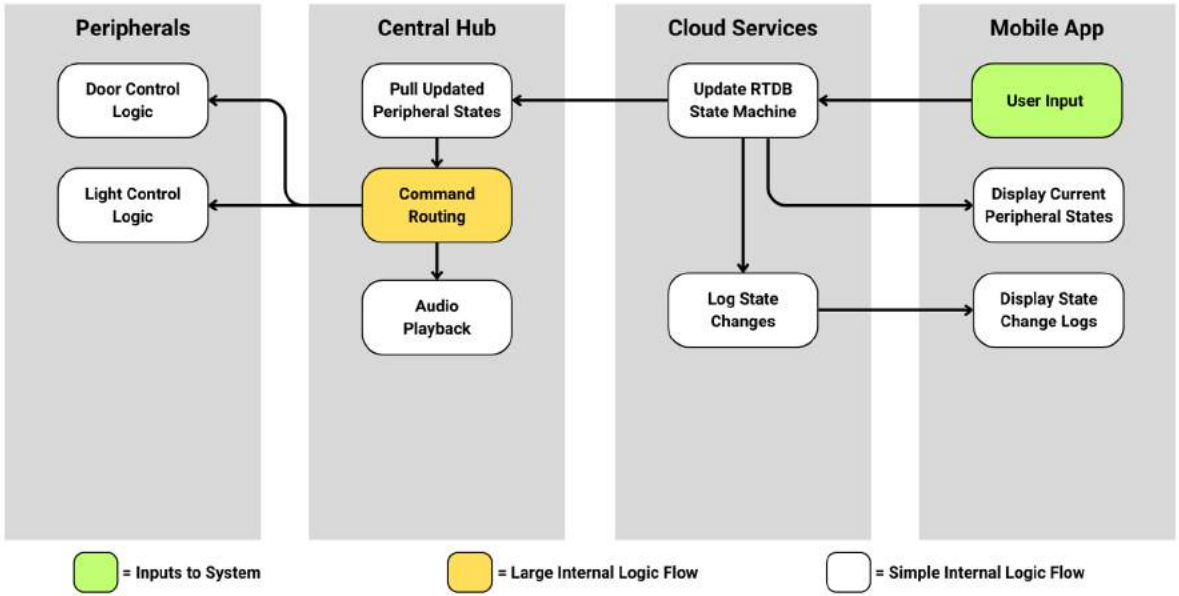
Full Software Flow



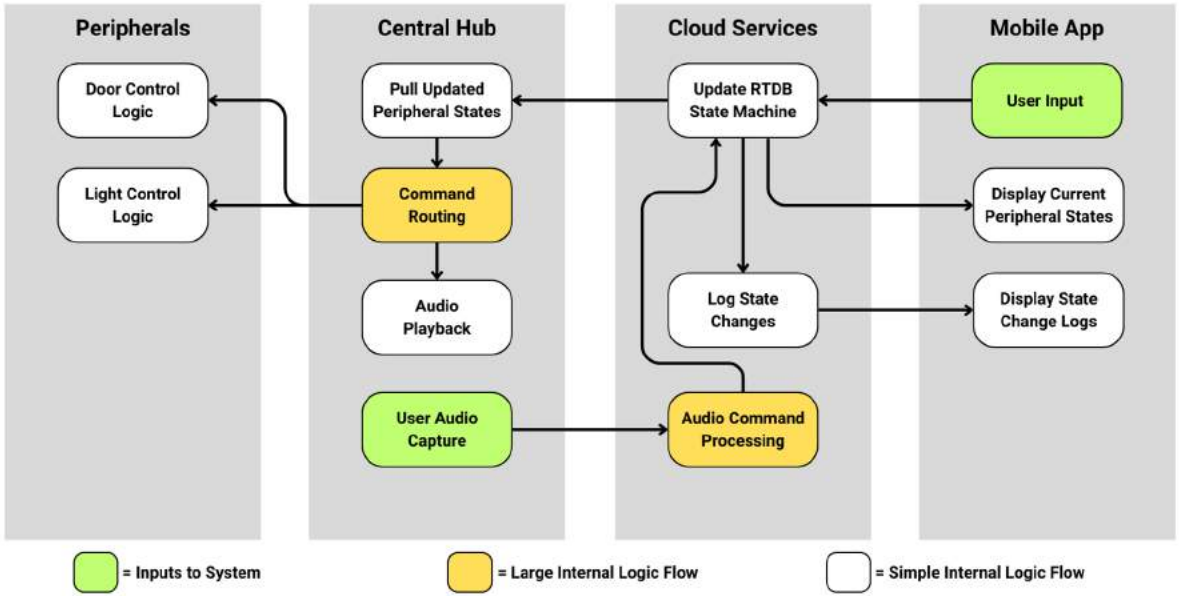
Full Software Flow



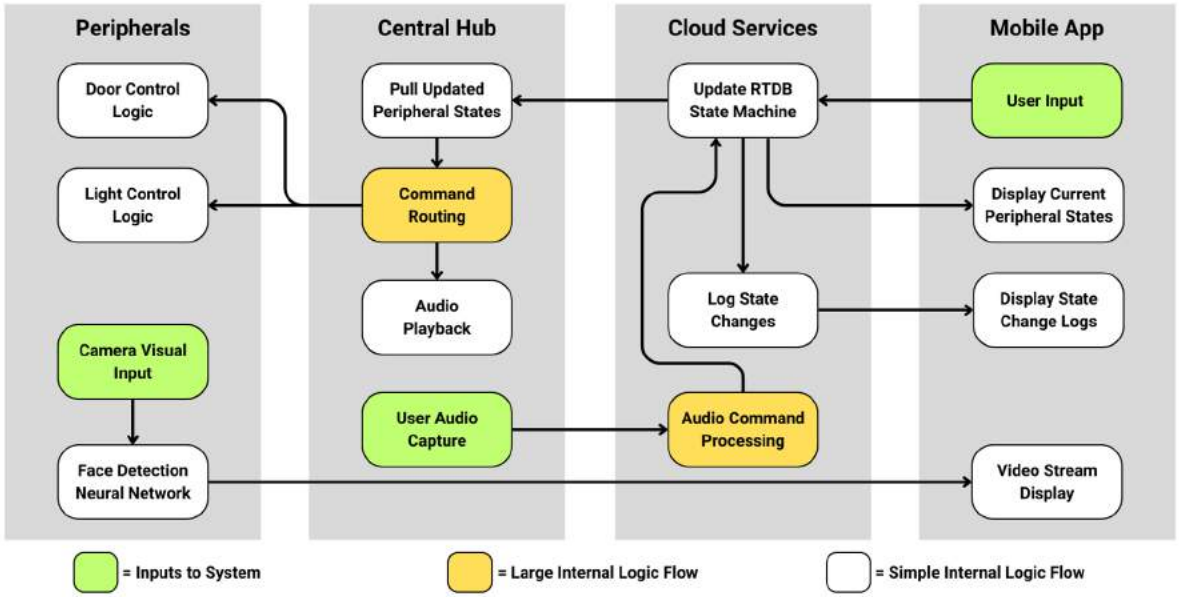
Full Software Flow



Full Software Flow



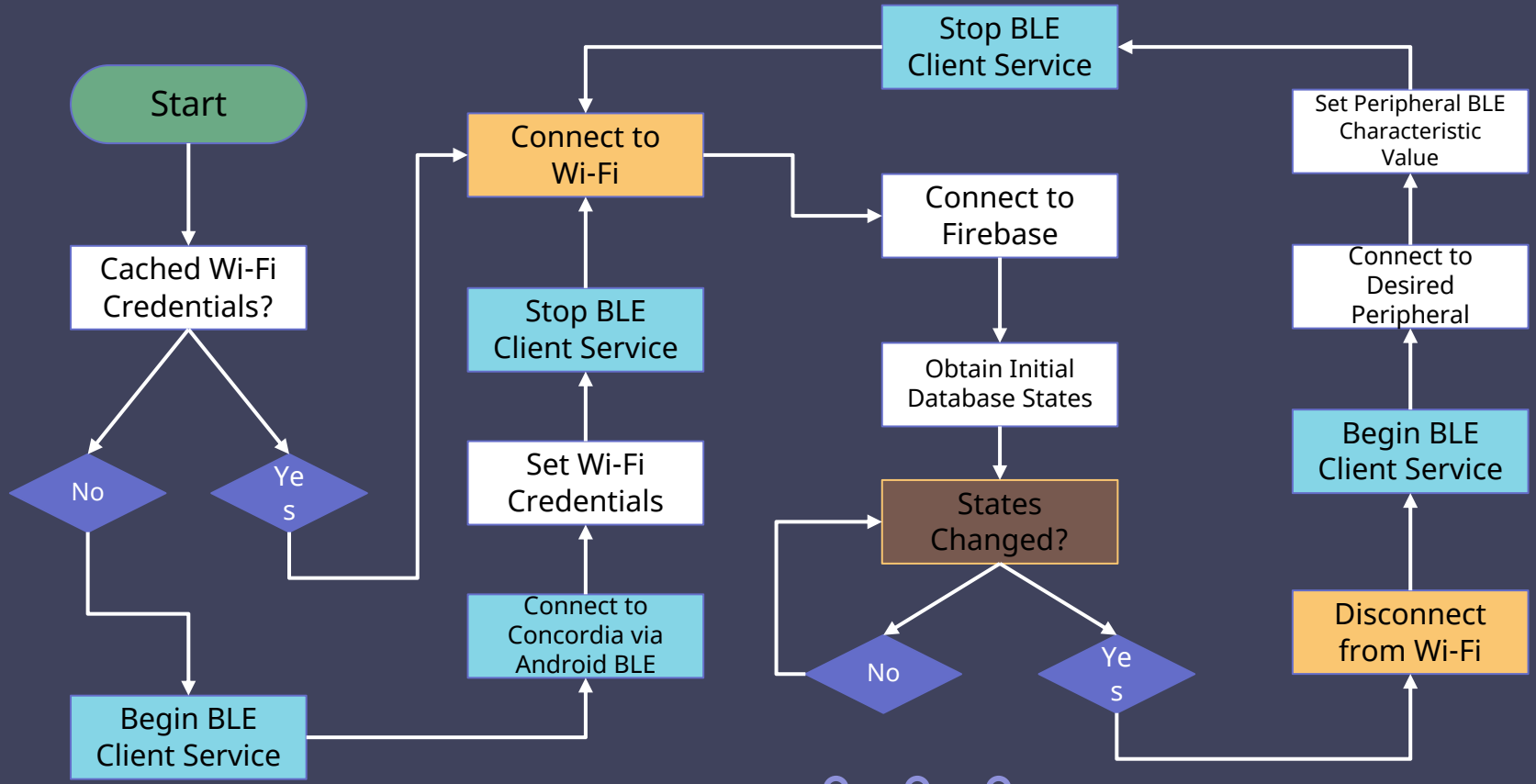
Full Software Flow



Concordia Connectivity

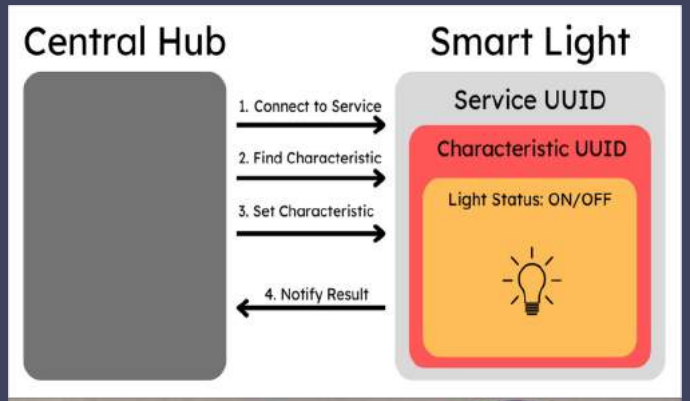
- Wi-Fi
  - Firebase Realtime Database
  - Firebase Storage
- Bluetooth Low Energy (BLE)
  - Phone Pairing
  - Peripheral Communication
- NORA-W106 Antenna
  - Essential Resource

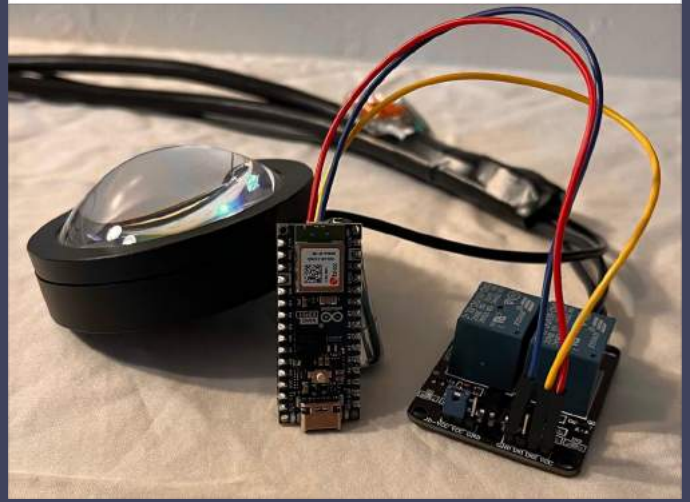
Bluetooth & Wi-Fi Diagram



Smart Light

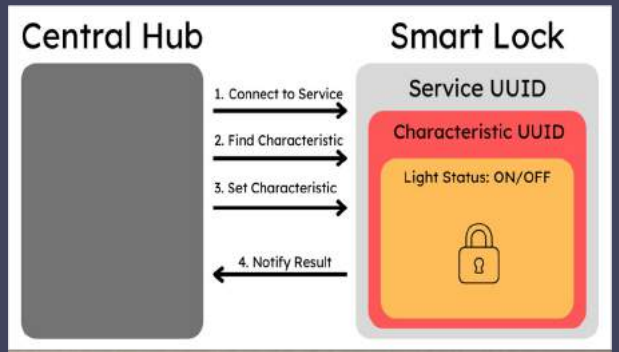
- Configured via BLE from Central Hub
  - Characteristic Value
- Relay Module
  - SRDSRD-05VDC-SL-C
  - Normally Open State

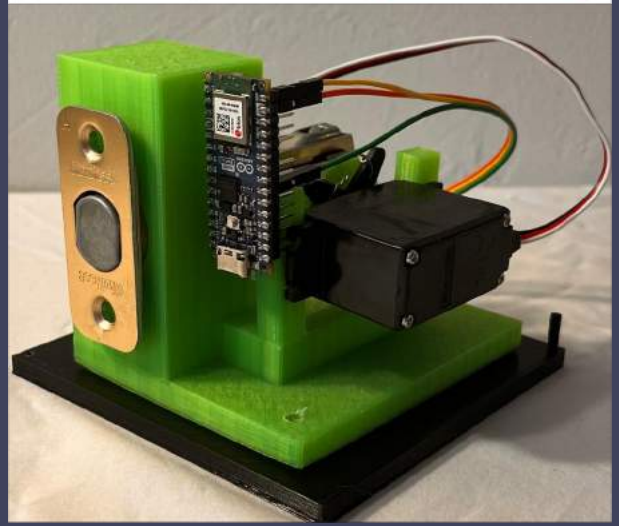




Smart Lock

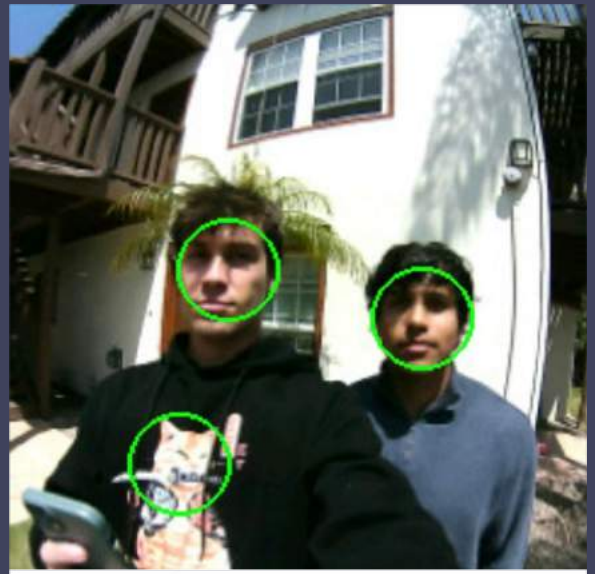
- Configured via BLE from Central Hub
  - Characteristic Value
- Servo Motor TowerPro MG959
  - PWM Protocol

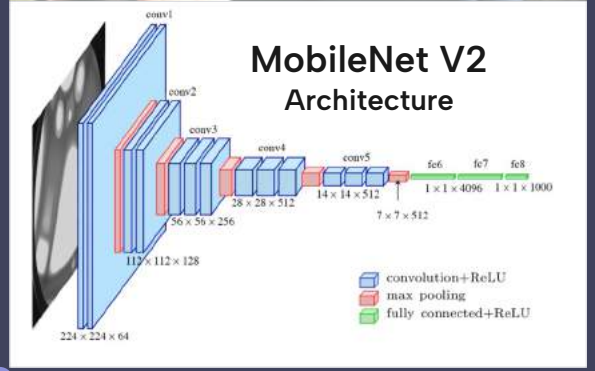




Smart Camera

- The smart camera broadcasts stream url to cloud
- Mobile app pulls and embeds the stream in the UI
- Uses FOMO model (modified version of MobileNet)
  - Cuts out downstream layers after ⅛ spacial reduction (after conv5)
  - Replaces it with alternate convolution layers using a per-region probability map
  - Final logits layer employs custom loss function to preserve object area locality

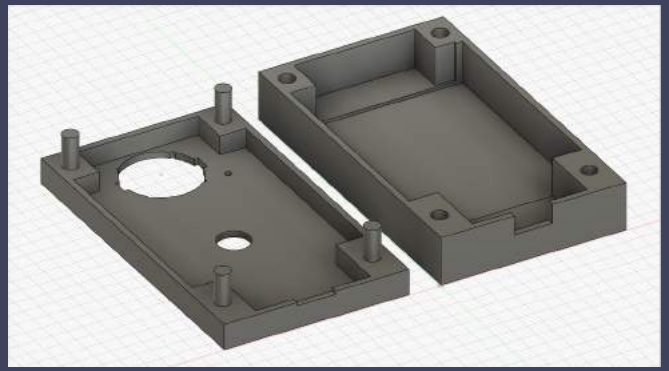


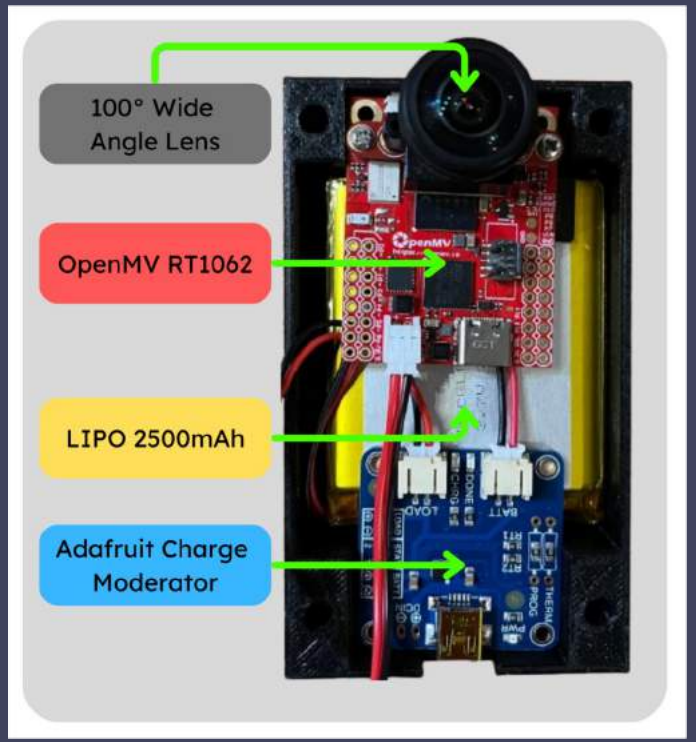


Smart Camera – Parts & Enclosure

- Internal Components –
  - OpenMV RT1062 (WIFI & Bluetooth)
  - SanDisk 128GB micro SD Card
  - LIPO 2500mAh Battery Pack
  - USB LiIon/Lipoly Charge Moderator Board

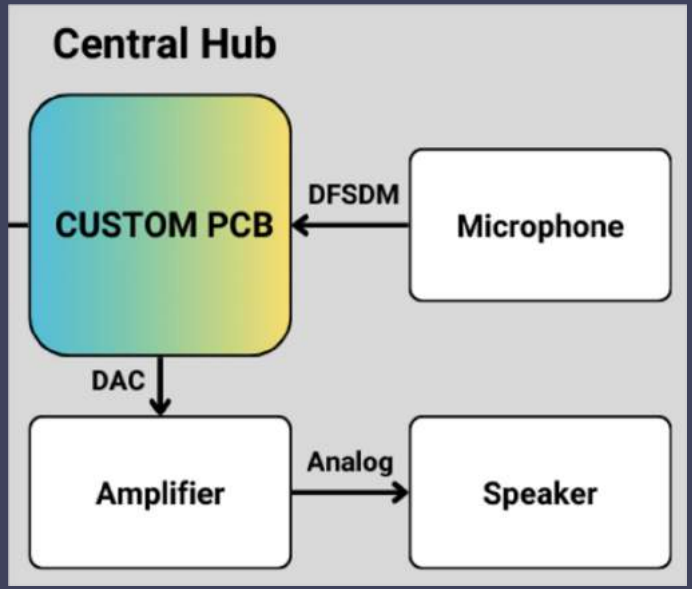
- 3D Printed Enclosure –
  - 58mm wide x 100mm long x 23mm deep





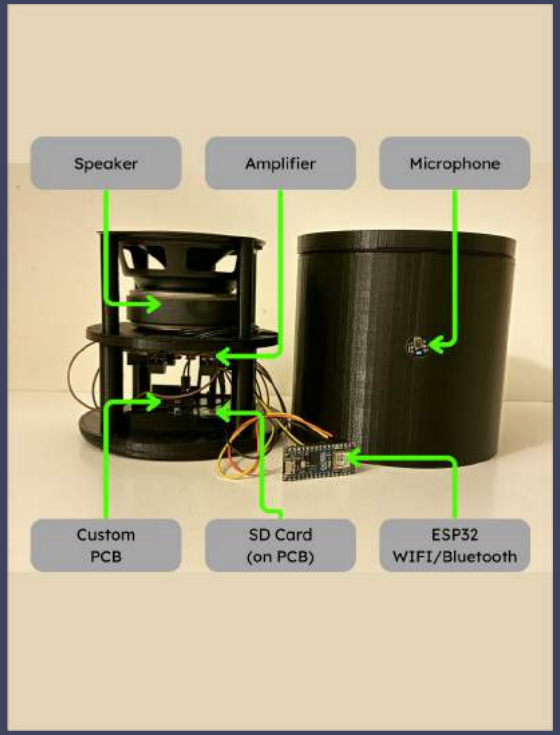
Central Hub Audio

- Incorporated into the central hub
- Functions as a feedback device for user actions with the central hub/app
- Can be used as a music player
- Has a microphone array which will be able to process voice commands
- Has on board storage to store audio files and recordings



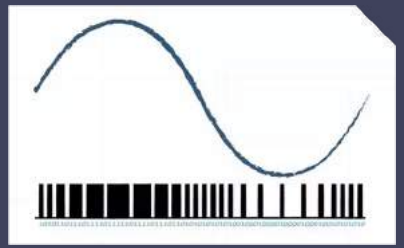
Central Hub Audio – Parts

- Parts –
  - Class D Audio Amplifier Board
    - AA-AB32231
  - Full Range Speaker @ 8 Ohm Impedance
    - PC105-8
  - MEMS Microphone
    - IMP34DT05 PDM Microphone



Central Hub Audio – Functionality

Audio Input



DFSDM Peripheral allows us to encode PDM samples with hardware yielding PCM data which can be used to build a WAV file

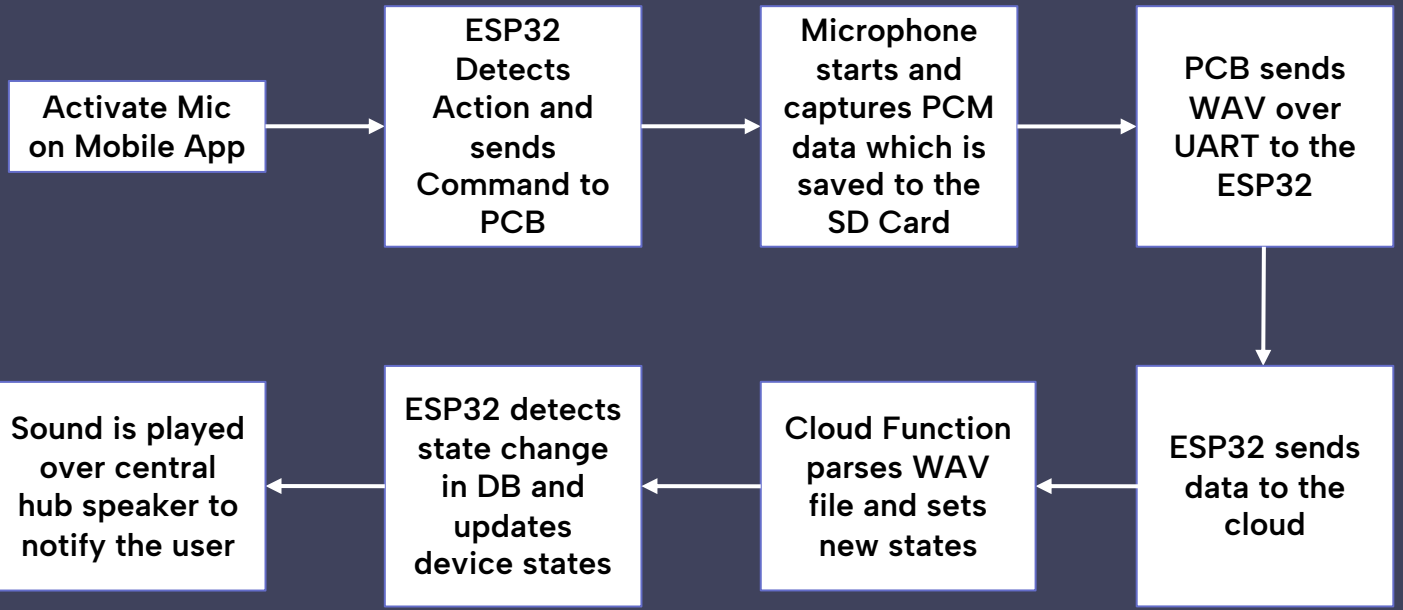
Audio Output

On board DAC paired with a Timer is used to playback PCM samples in real time

Storage

On board storage is used to save captured microphone data and to play audio files through the speaker

Voice Recognition Pipeline

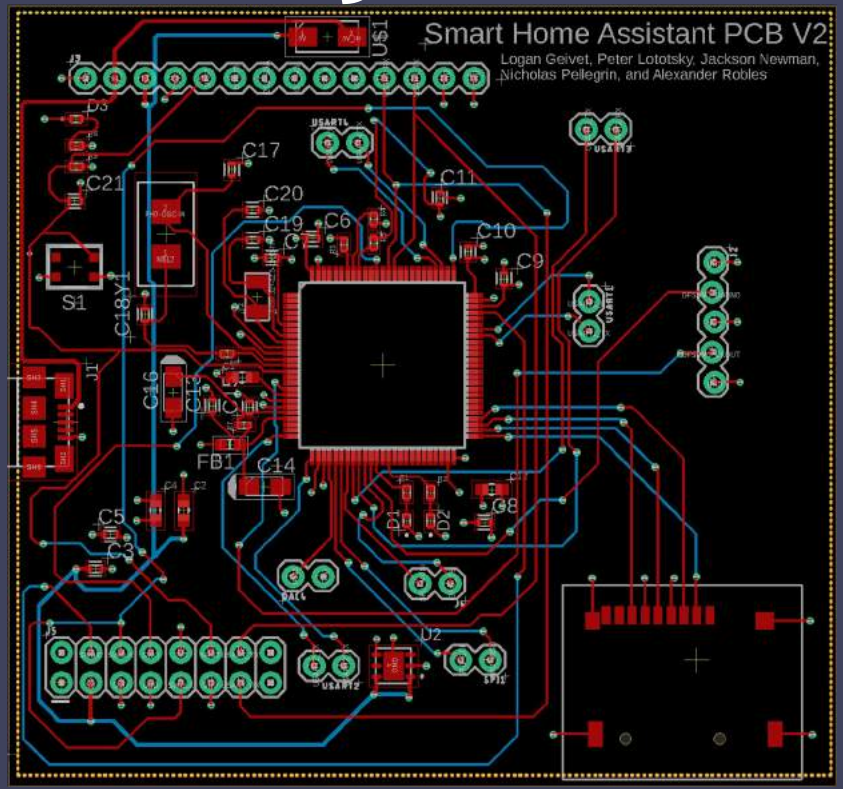


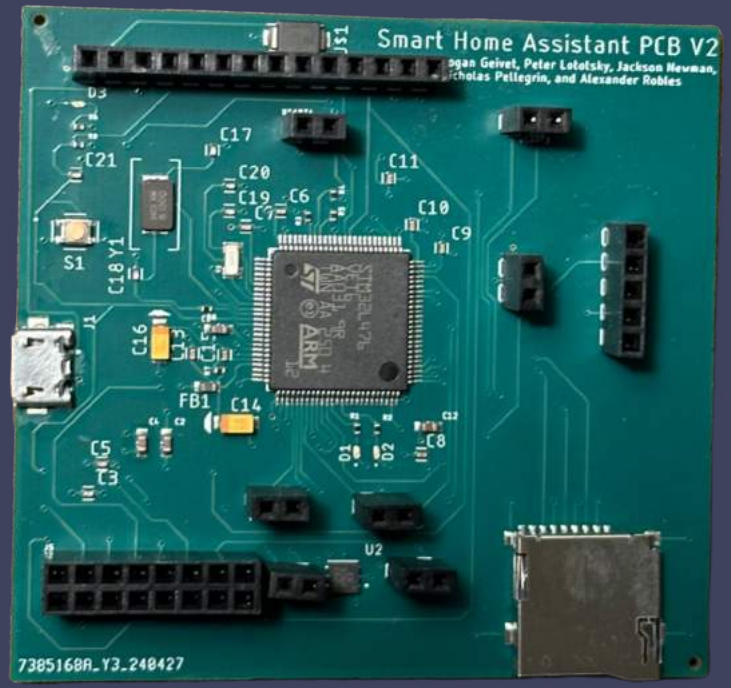
The Cloud & Mobile Application

- Cloud is the main endpoint between central hub and Android mobile application
  - Realtime database with data fields relating to all peripheral devices
  - Storage bucket for camera video streaming
  - Log function for viewing past changes
  - Easy to use User Interface on Mobile App

PCB Design

4 Layers
66x73mm





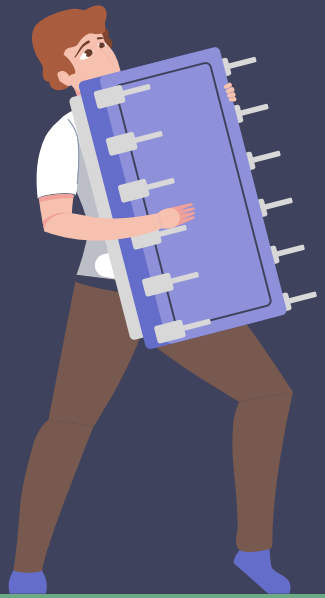
Final Demo – Whole Project

Possible Future Goals

- Connect the smart lock with the facial recognition ability of the smart camera to make a face ID accessible door
- Add movement detection to smart cam that pings the central hub to play a doorbell audio
- Add music streaming to central hub, controllable through the app
- Video Logs from smart camera of scenes of interest (movement, etc.)
- Implement wake up words

Thank you!

Do you have any questions?
github.com/Smart-Home-Assistant



Acknowledgments

- Dr. Yogananda Isukapalli
  - TA Brian Li
  - TA Eric Hsieh
  - TA Alex Lai