University of Central Florida

# *PET CONNECT*

**Group 10 - Senior Design Fall 2020**
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Ryan Flynn, CPE

# What is Pet Connect?

- IoT device designed for automated pet door that use with existing sliding glass door.

- Main functionality is to open/close the door by using remote communication through Mobile Application.

Joy CPE

# Motivation

**Problem With Pet Owners Away From Home**:

- Causing a pet's anxiety and stress due to lack of outdoor activities.
- Increasing pet's destructive behavior such as chewing, digging, or scratching furniture.

**Problem With Traditional Flap Pet Door:**

- Require cutting a hole in the glass, a door, or a wall.
- Limitation of pet size per a pet door flap.
- Professional Installation

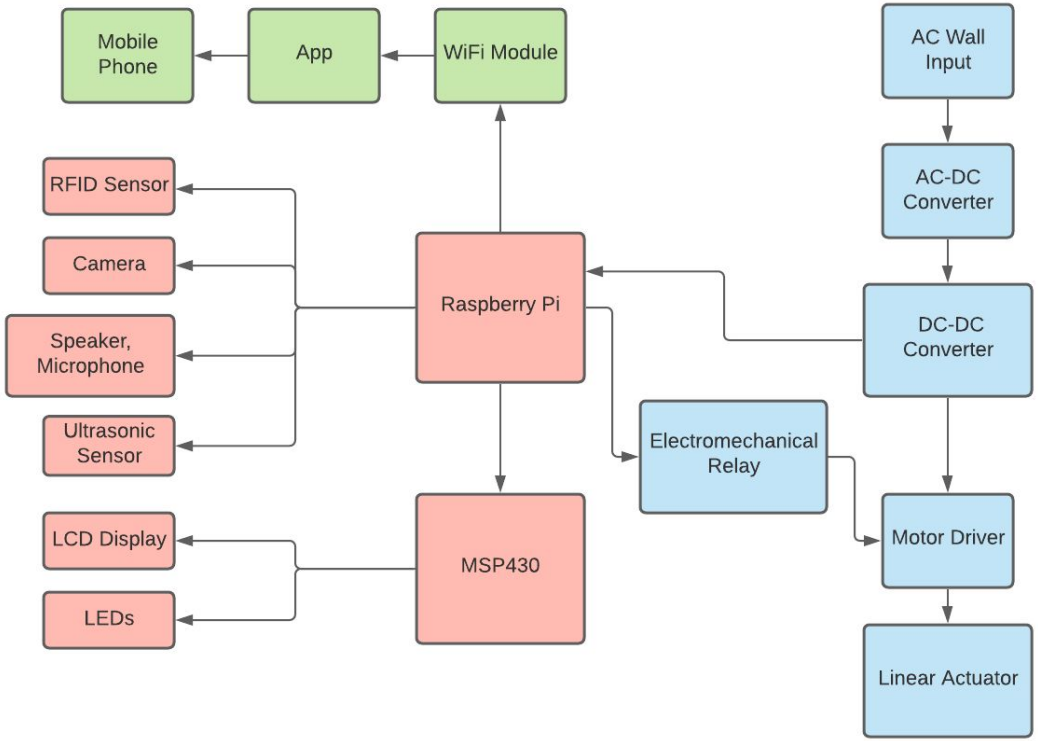
# Goals and Objectives

- Create automated system to open, and close the door.
- Remotely control the device  via mobile application interfaces.
- Sensors detection to notify users status of the device.
- Easy set up and installation to existing glass door.
- Keep the  pets healthier by allowing outside activities.
- Provide ease and convenience for pet owners while away from home.

# Specifications

| Requirement | Description | Value |
|---|---|---|
| Power Usage | Power to operate the system | 80 W |
| Sensor Range | Distance to verify the object | 24” detection - Ultrasonic Sensor<br>18” verification - RFID |
| Weight | Pet Connect main housing | Less than 10 lbs |
| Dimensions | Pet Connect main housing | 10” x 10” x 8” |
| Cost | Budget for Project | Less than $500 |

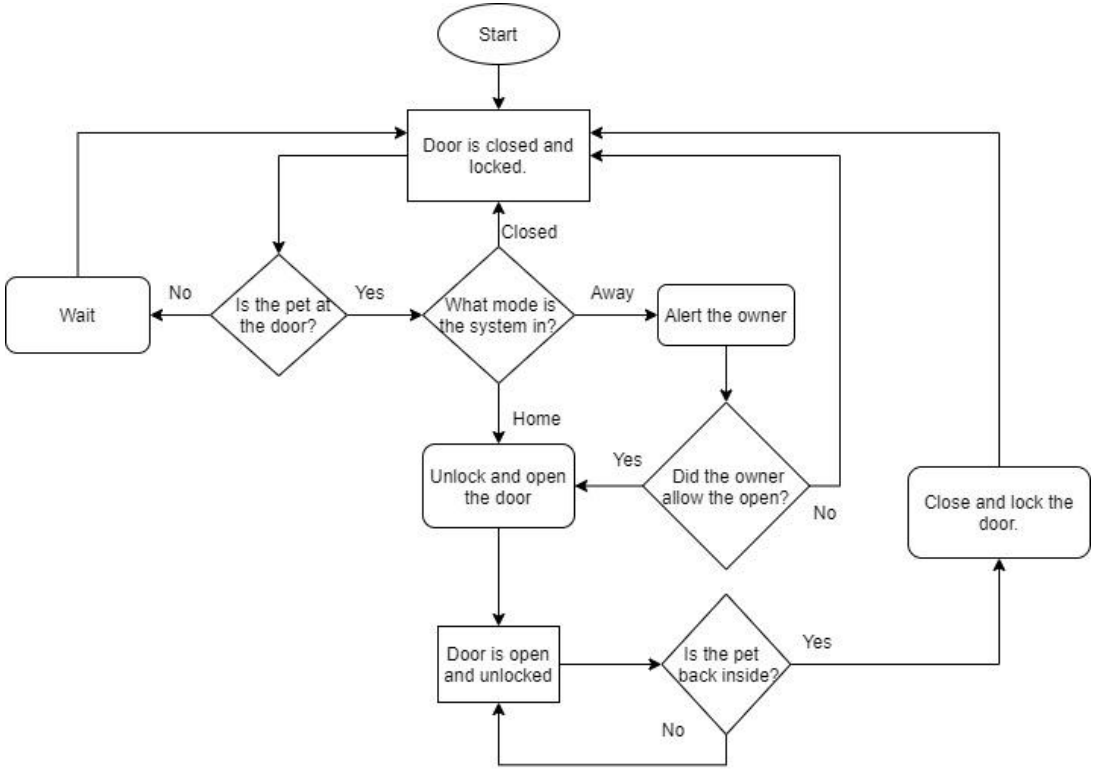
# Overall Block Diagram






Ryan CPE

# System Flowchart

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# Overall Power Diagram

AC-DC Power Supply
Wall Adapter

- 12 V, 8 A (-96 W)

12V Power Rail

- +60.8 W

5V Power Rail

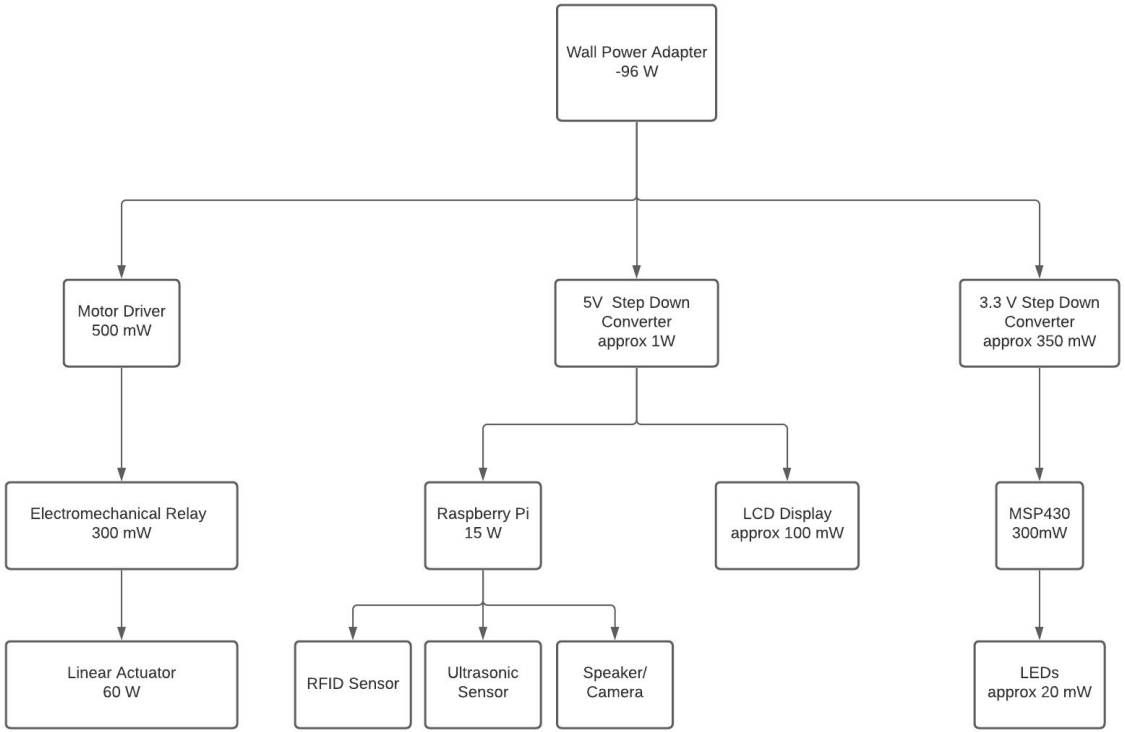
- +15.1 W

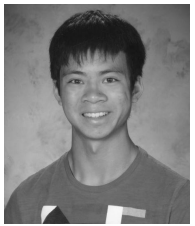
3.3V Power Rail

- +320 mW

Estimated Power Needed

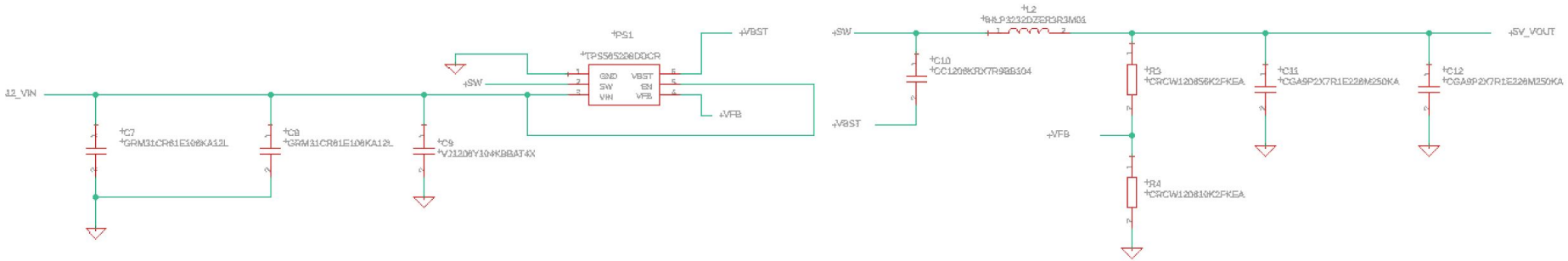
- +78 W

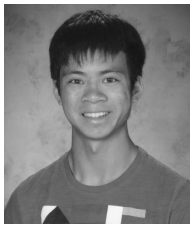


Michael EE

# 5V Step Down Converter



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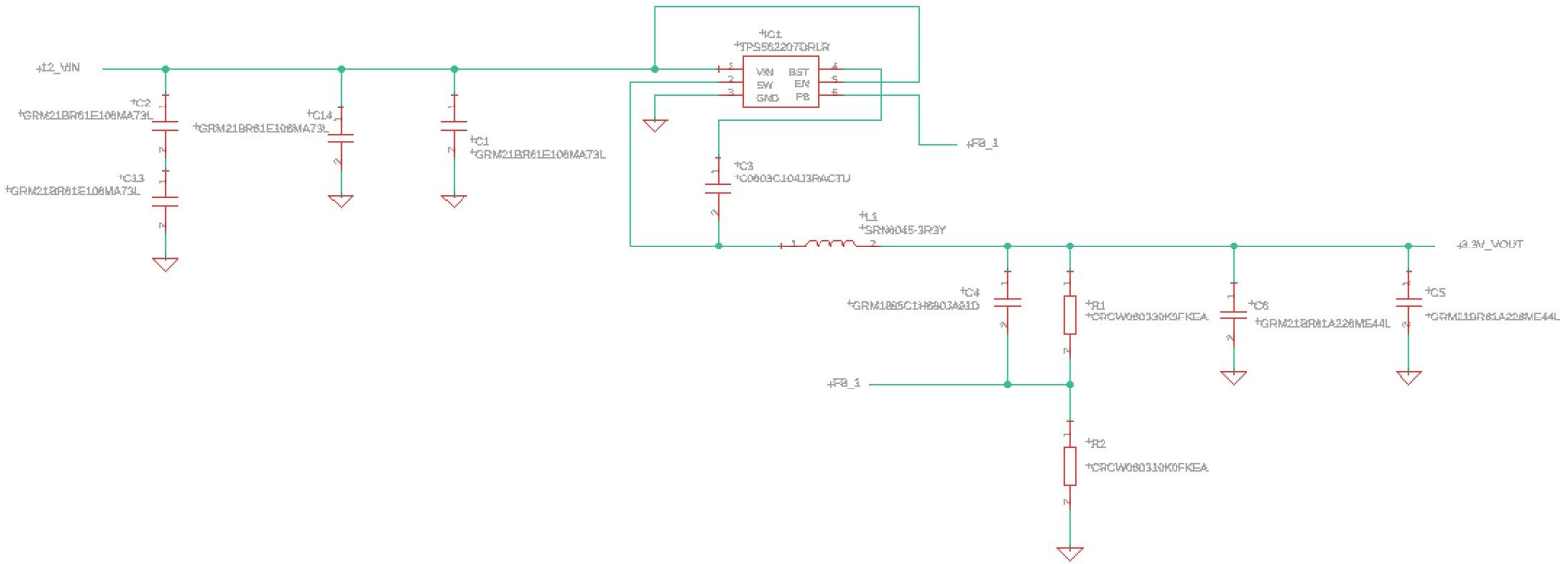
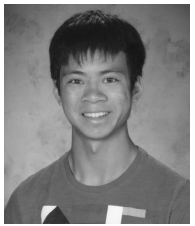
# 3.3V Step Down Converter



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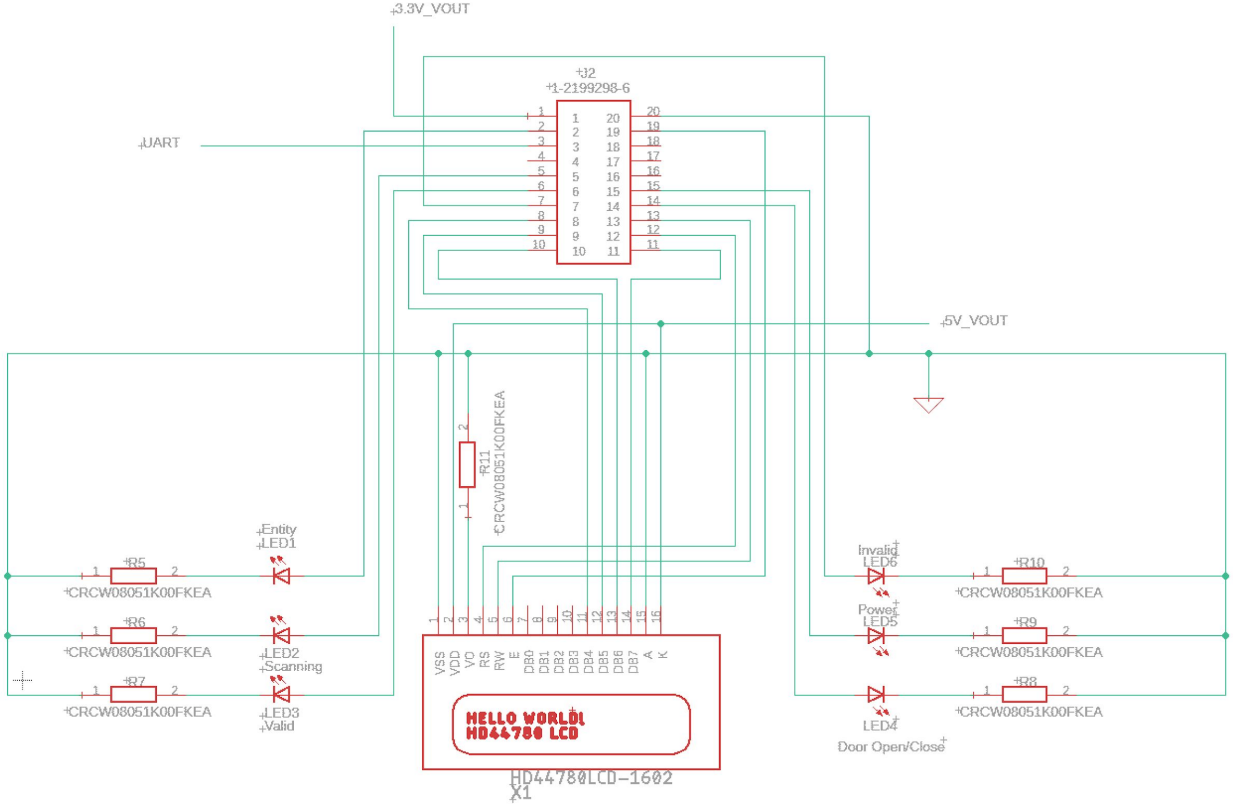
# Home User Interface

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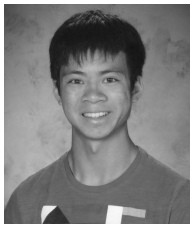

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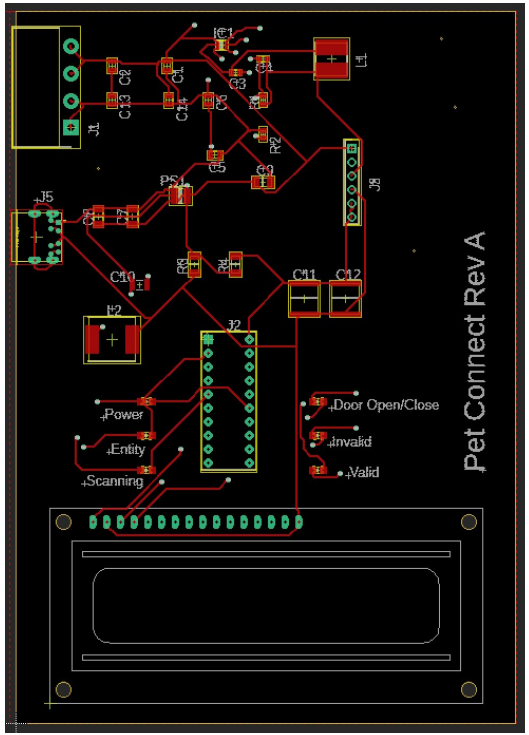
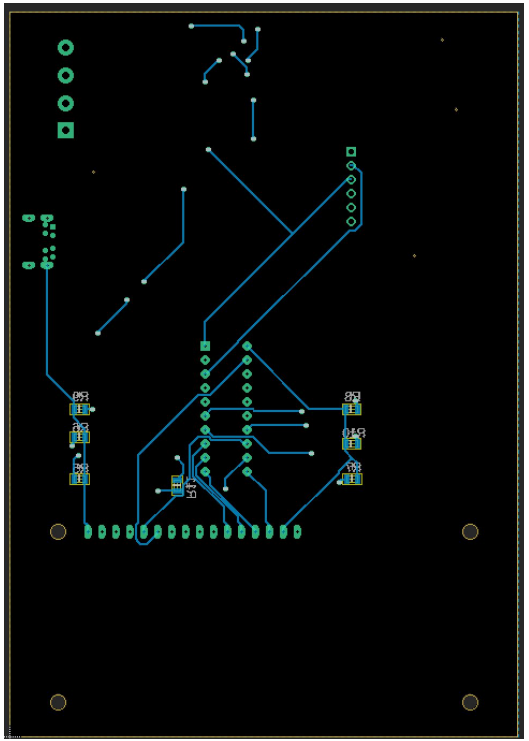
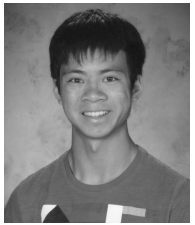
# PCB Design





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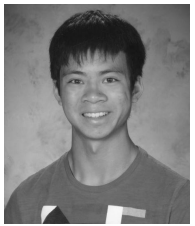
# PCB Testing

## PCB Bareboard/Continuity Test

- Check each node on the PCB bareboard to ensure electrical connection are printed correctly using a multimeter

## Power-only Test

- Testing each output nodes for 5V and 3.3V buck converter
- J3 Connector is a test connector



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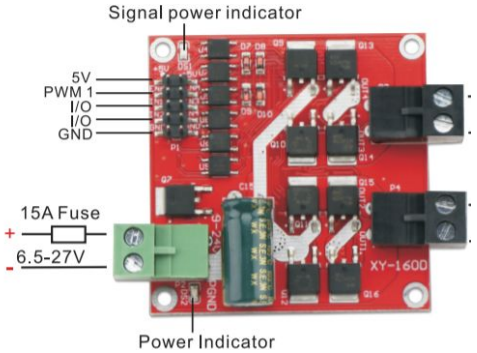
# Motor Controller Components

## H Bridge Motor Driver

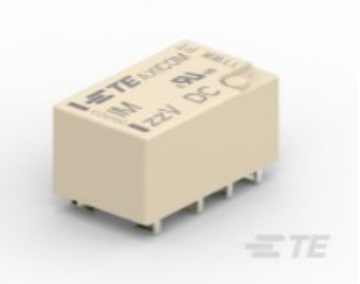
- *DROK L298 Dual H Bridge Motor Speed Controller*
- 7A Maximum Output per driver
- Optocoupler Isolation for control signals

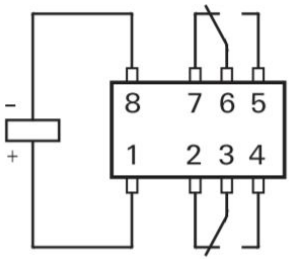


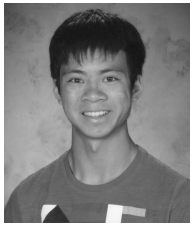

| IN 1 | IN 2 | ENA 1 | OUT1、OUT2 |
|---|---|---|---|
| 0 | 0 | x | brake |
| 1 | 1 | x | Floating |
| 1 | 0 | PWM | Forward to speed |
| 0 | 1 | PWM | Reverse speed |
| 1 | 0 | 1 | Full speed forward |
| 0 | 1 | 1 | Full speed reversal |

## Signal Relay

- *TE Connectivity's Signal Relay (5-1462037-3)*
- Minimum Turn-on Coil voltage = 2.4 V
- Maximum Turn off Coil Voltage = 0.3 V
- Maximum Current Pin = 2A
- Typical Bounce Time = 1 ms





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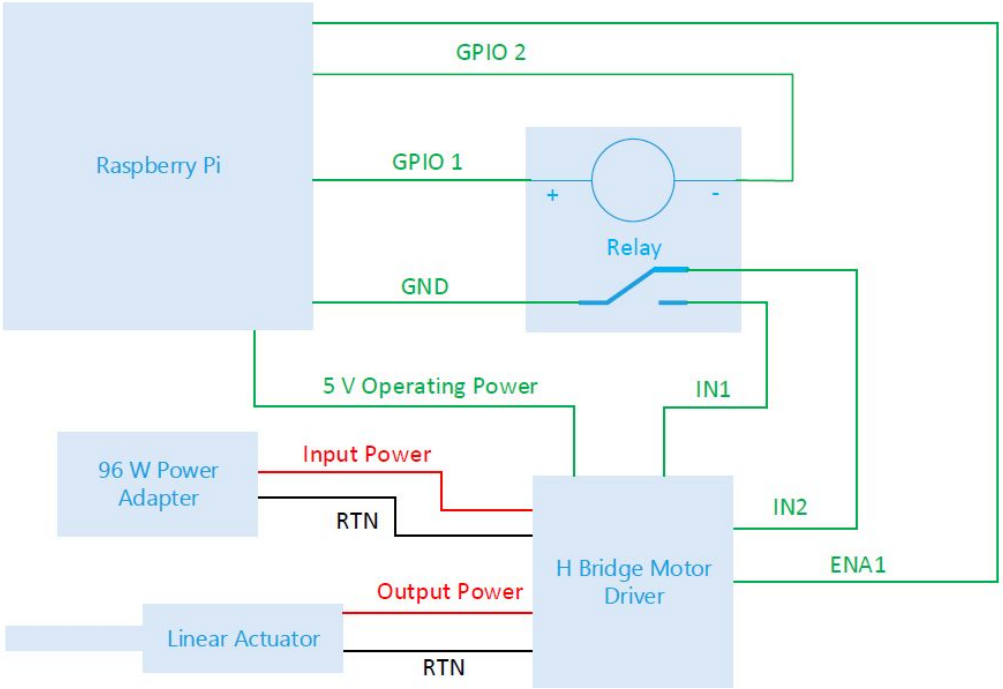
# Motor Control Circuit

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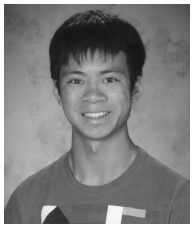

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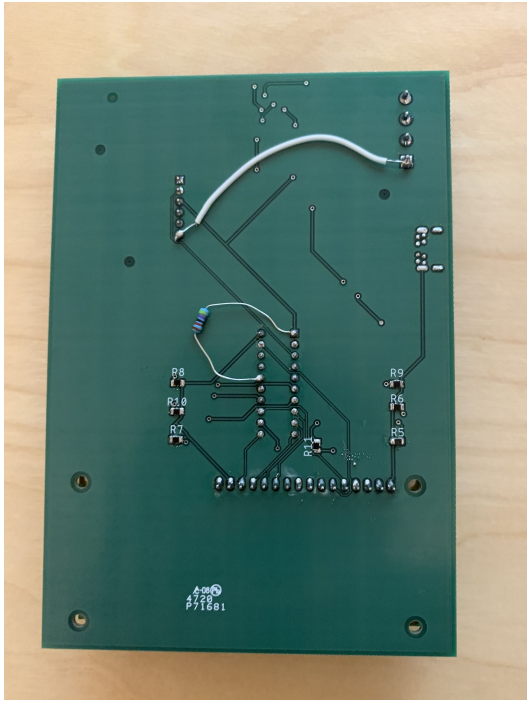
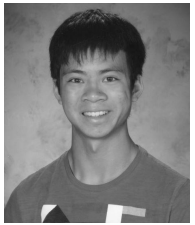
# PCB Improvement

Lesson Learned:

- Remove C13
- Applied 5V to pin 15 (pin A) and GND to pin 16
- Add 47k ohm pull-up resistor for MSP430
- Add GND connection to left and right side of the board



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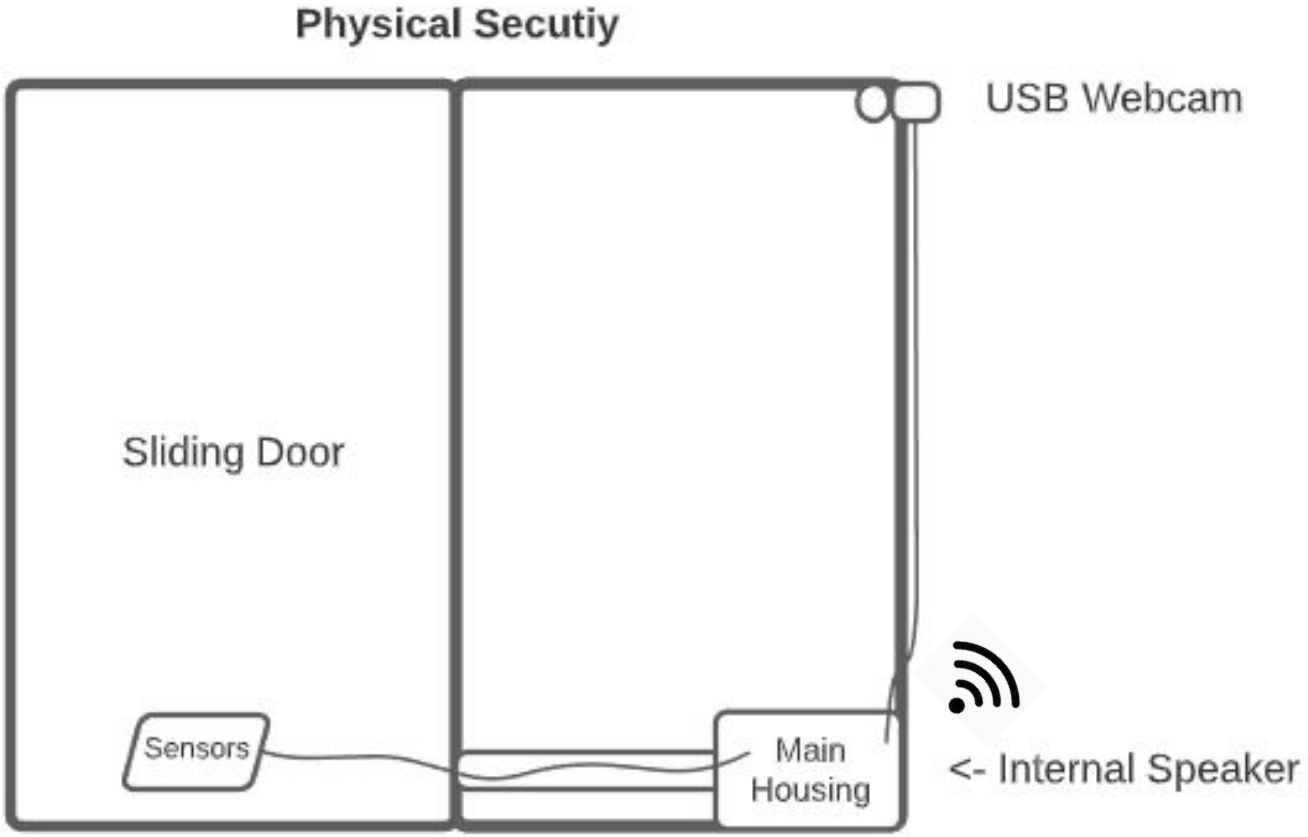
# Design Approach - Computing

## Raspberry Pi 4

- 4GB RAM and enough processing power to handle video and other IO.
- Ease of use - Built in wifi, 40 pin GPIO, 4 USB
- Large support community
- Supports multiple language and hardware libraries
- $100

# Design Approach - Physical Security

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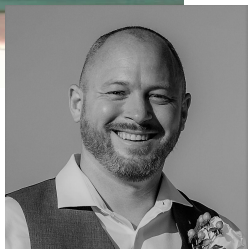
# Logitech C270 / USB Speaker

- HD Webcam - 60° FOV
- Offers 720p @ 30fps
- Built-in microphone with 3 meter reception range
- Uses USB 2.0 or 3.0
- 5’ USB cable included
- USB powered
- $40.00

- USB Speaker - no external power
- Small footprint >4”x2”x2”
- $12.99

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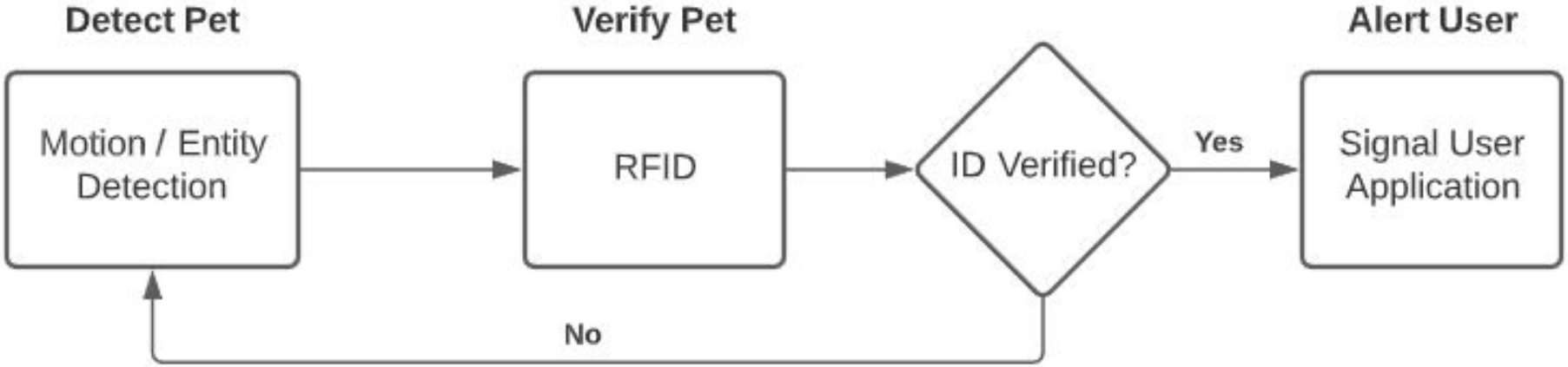
# Design Approach - Sensing



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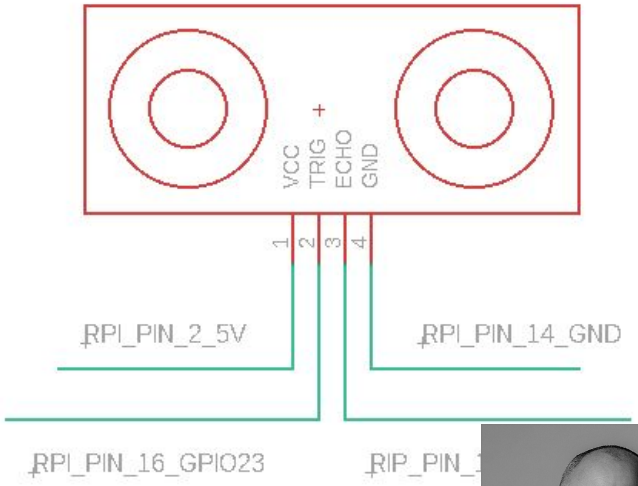
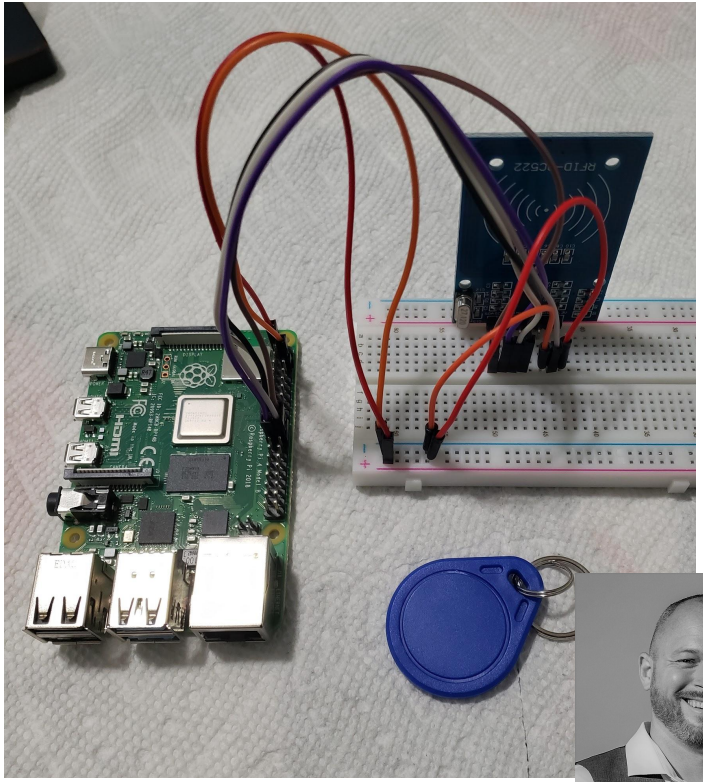
# HC-SR04 Ultrasonic Sensor

- Measuring Distance: >450 cm
- Design Distance: <25 cm
- High accuracy: +/- 3 mm
- Experience using in Jr Design
- Not susceptible to heat and light interference
- Size offers desired physical design implementation
- Free - already owned




# RC522 RFID Module

- Supports I2C, UART, and SPI
- Read Range: ~5 cm
- Read and write operations allow for User customization and reuse of tags
- Conumes ~10 uA when idle
- 4 SPI pins, 1 GPIO, 3.3v, Gnd
- Small footprint fits door attachment design
- Compatible with collar-like tag
- $7.00



# Testing our sensor design

All code was written in Python on Raspberry Pi

Physical implementation done with breadboard kit

## Ultrasonic Sensor

- Created and looped the code for continuous sensing
- Tested sensing with multiple objects and in various environments
- Determined and implemented a threshold range for sensor to trigger ID verification

## RFID

- Tested “Read” operation for both ID tags
- Created and tested code for invalid tag
- Created and tested code for valid tag
- Created and tested code for reader timeout

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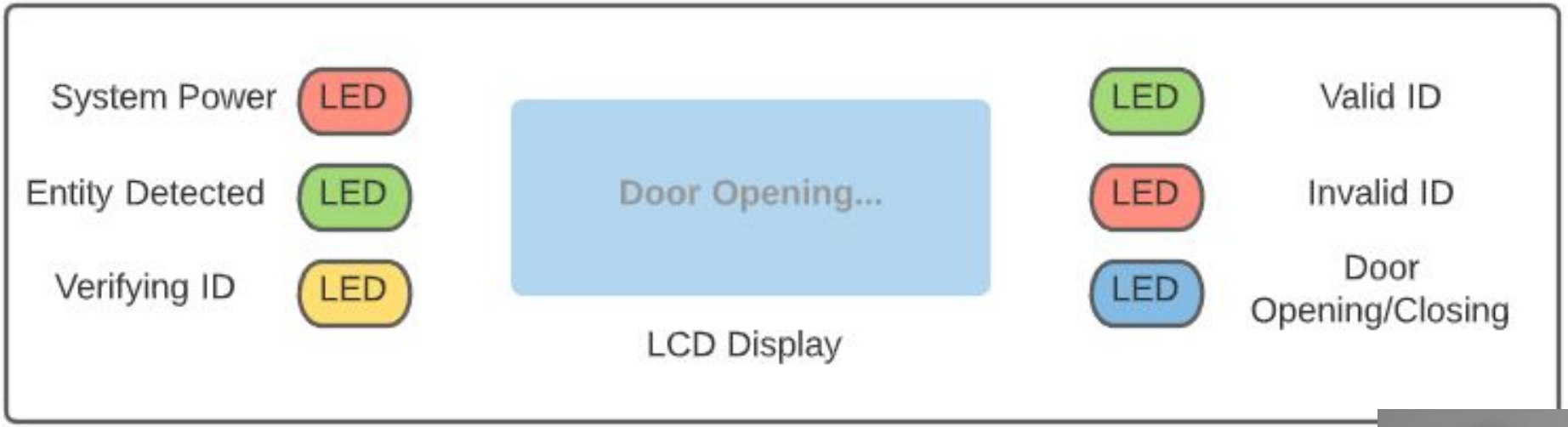
# Design Approach - User Interface



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# MSP430G2553

- Low power, <300uA
- 17 GPIO pins (15 needed for design)
- Uart, SPI, I2C
- Experience using in Jr Design


- Controls User Interface operations
- Will communicate with the Raspberry Pi via UART
- Free - already owned



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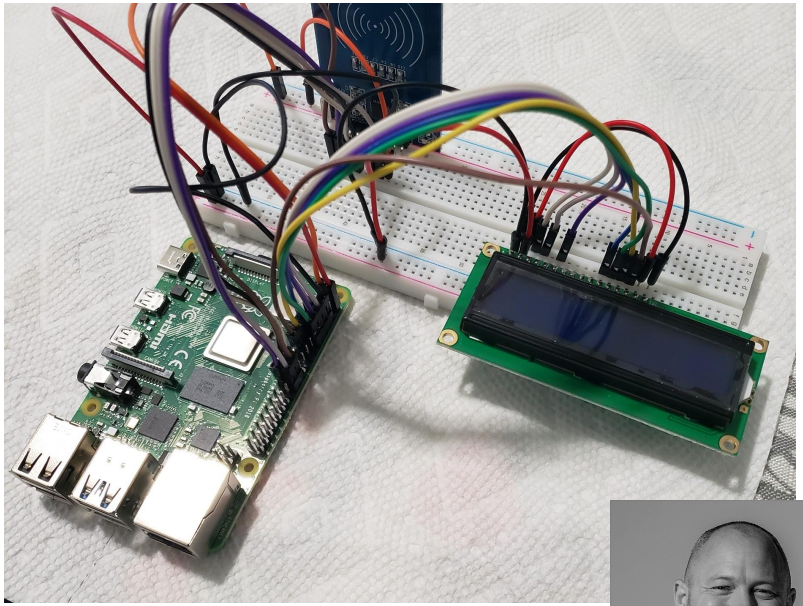
# LCD 1602

- Offers 16x2 character display
- 7 GPIO, 5v, Gnd
- Experience using in Jr Design
- Used to display active operation
- Size offers big enough screen while small enough to fit on housing
- Free - already owned



# Testing our User Interface

All code was written in C on MSP430

Physical implementation done with breadboard kit and MSP launchpad

Created functions for each system operation that controls the LCD and associated LEDs

Displayed message(s) for each system operation on the LCD

Enabled or disabled LEDs for each system operation

Created functions for UART communication with Raspberry Pi

Created and enabled Interrupts for the UART comms

Tested each system operation initiated from UART interrupts.



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# Software Overview

Firebase Realtime Database

Java™

Wi-Fi



Android Studio

python™

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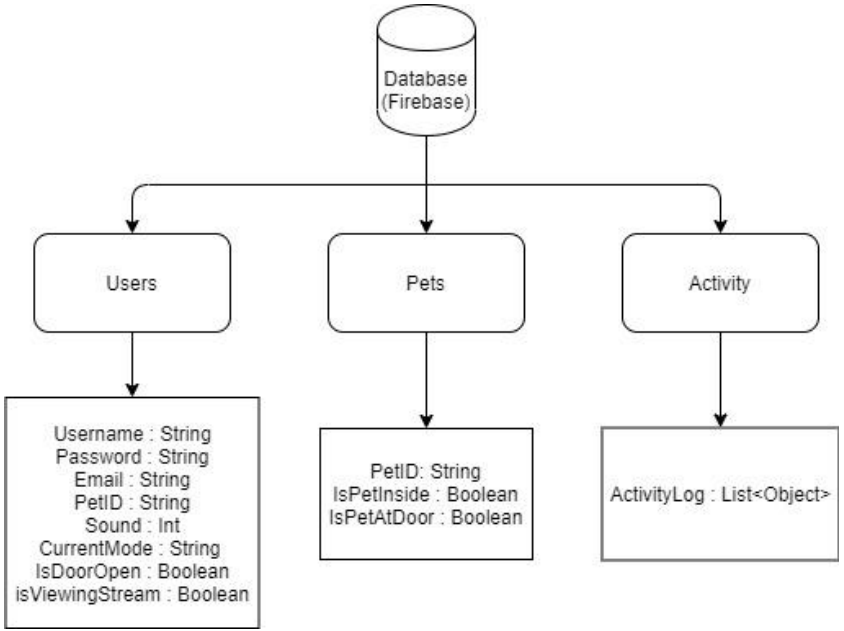
# Realtime Database

- Google Firebase Realtime Database is being used to store user's data.
- Allows for all components to continuously stay updated.
- Uses a JSON tree structure to organize the data.

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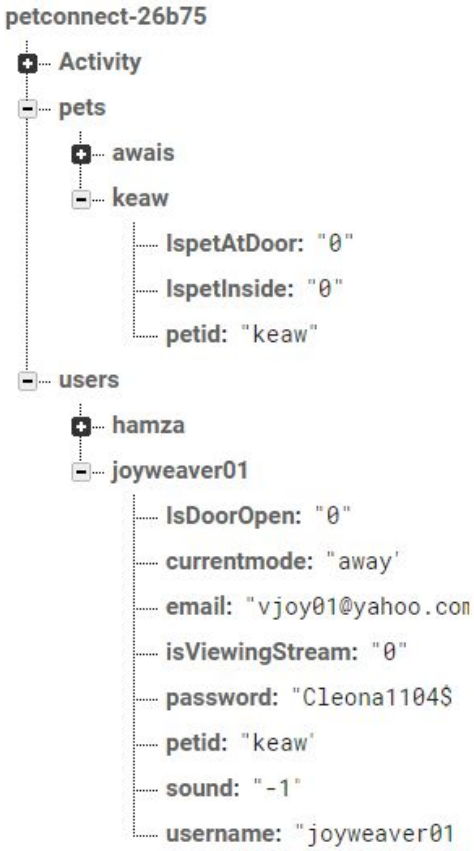
# Database Testing

- Google Firebase Console
- Test Cases:
  - Writing the correct data
  - Reading the correct data
  - Time it takes to see an update
  - Accessing the correct nodes

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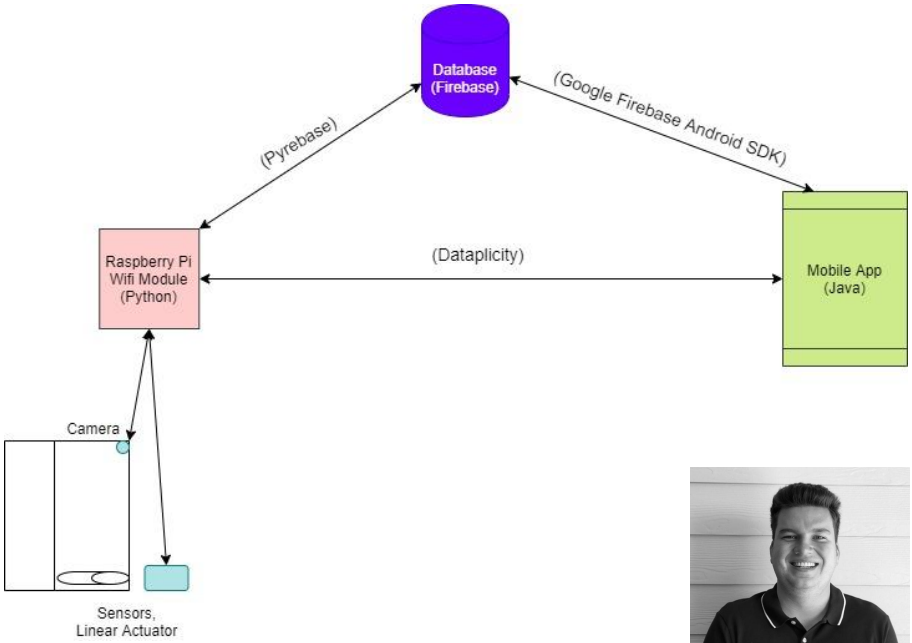
# Wireless Communication

- Firebase Android SDK and Pyrebase to interact with the database.
- Live Video Streaming
  - Dataplicity Wormhole and Hawkeye.



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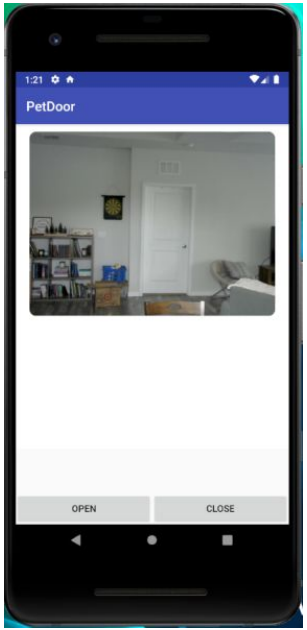
# Wireless Communications Testing

- Data Change Listeners
- Dataplicity Wormhole
- Test Cases:
  - Android Event Listeners
  - Pyrebase Streams
  - Viewing the Video Stream

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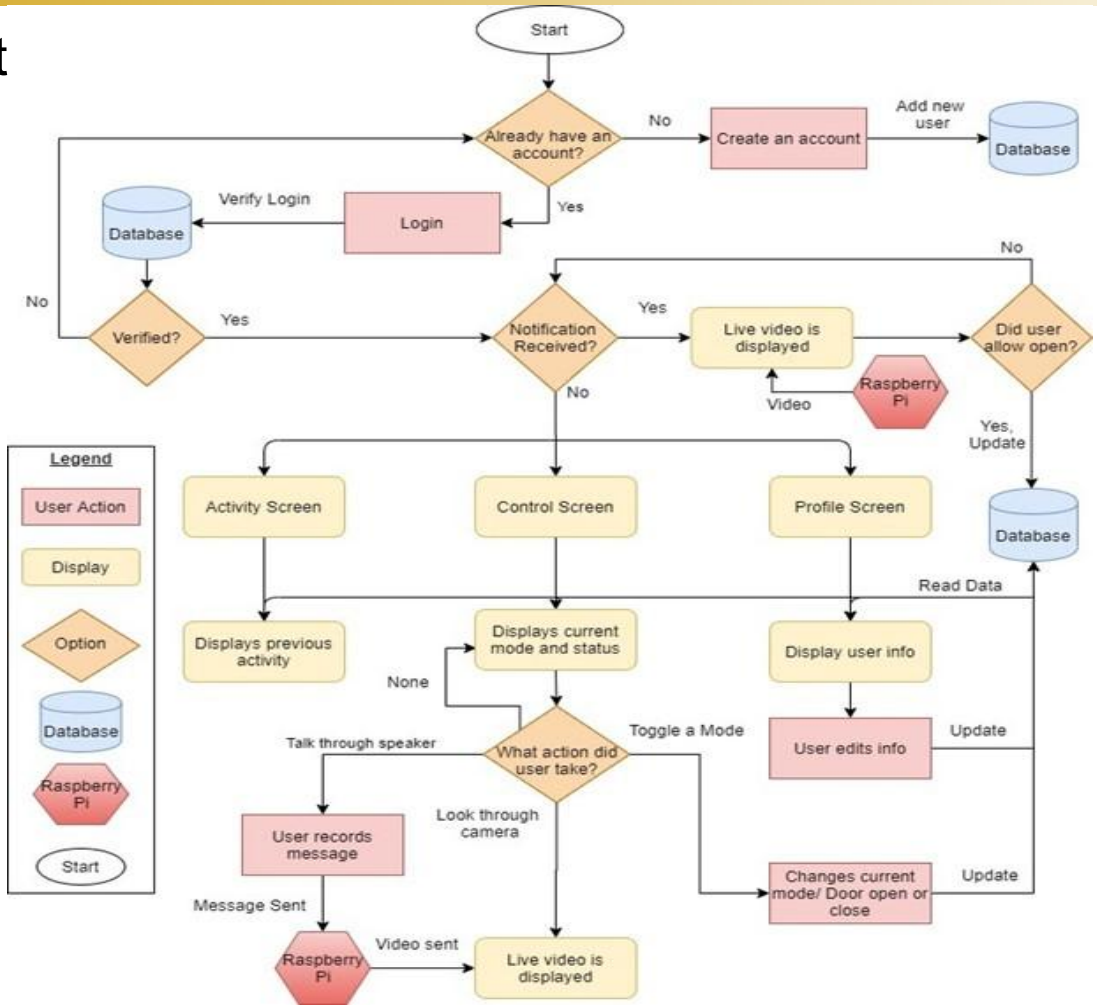
# Mobile App Flowchart

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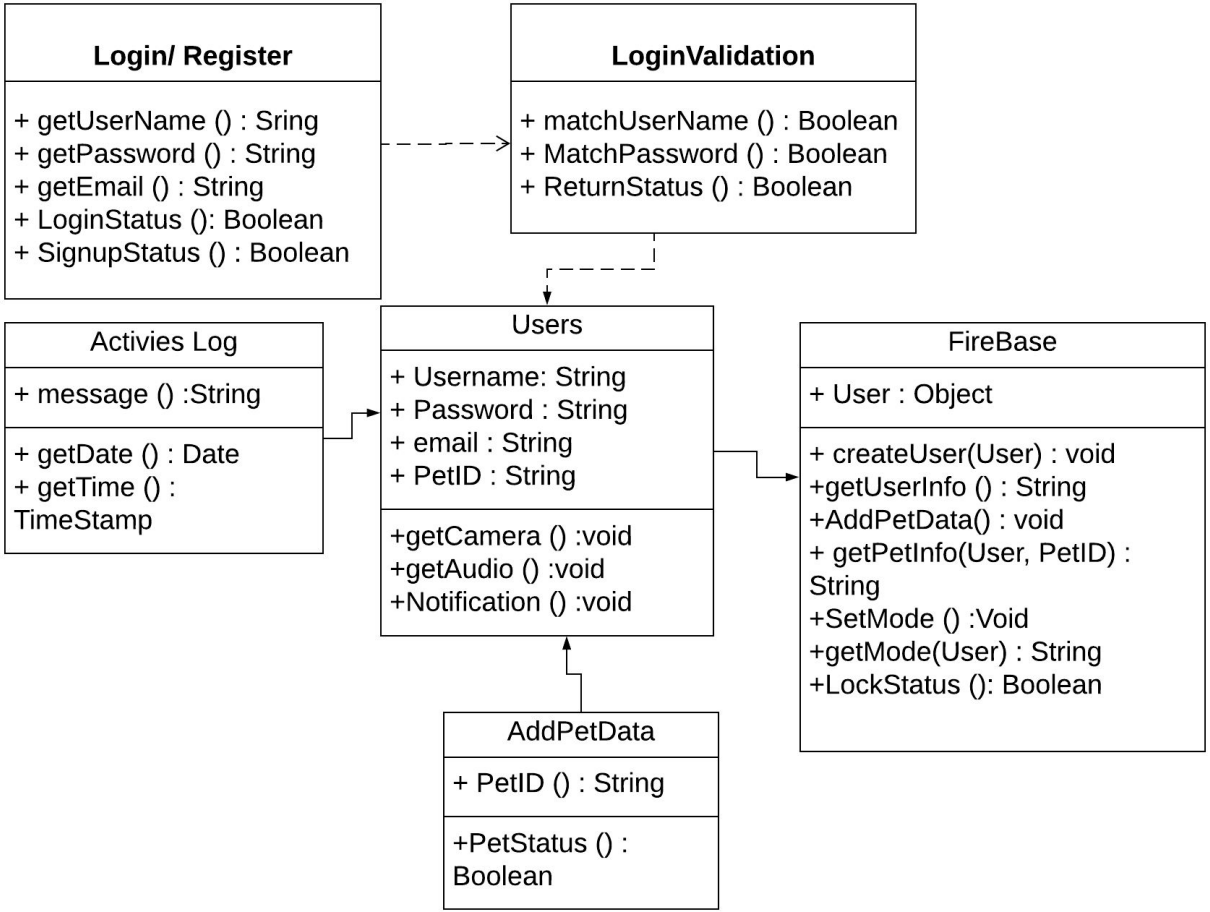
# Class Diagram

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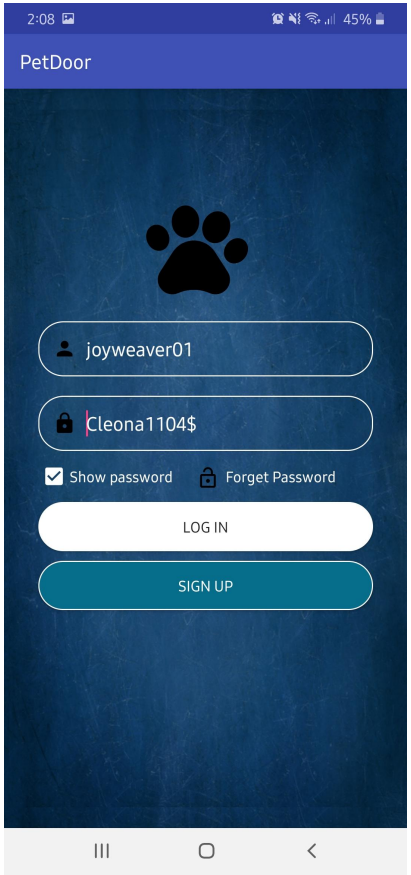


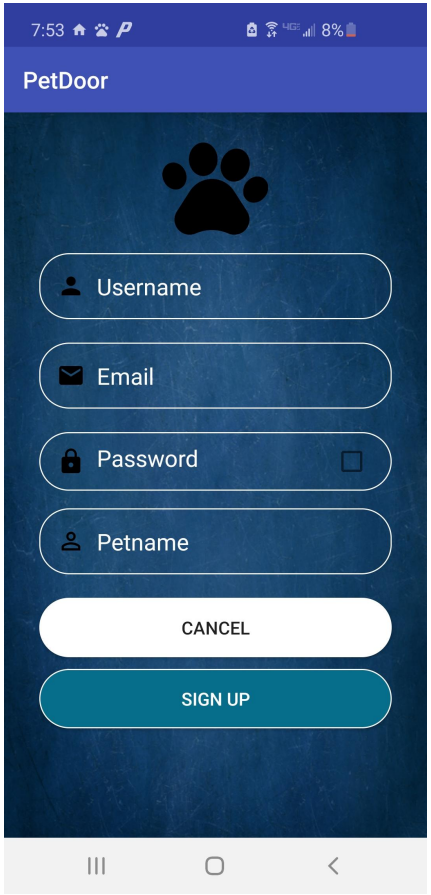


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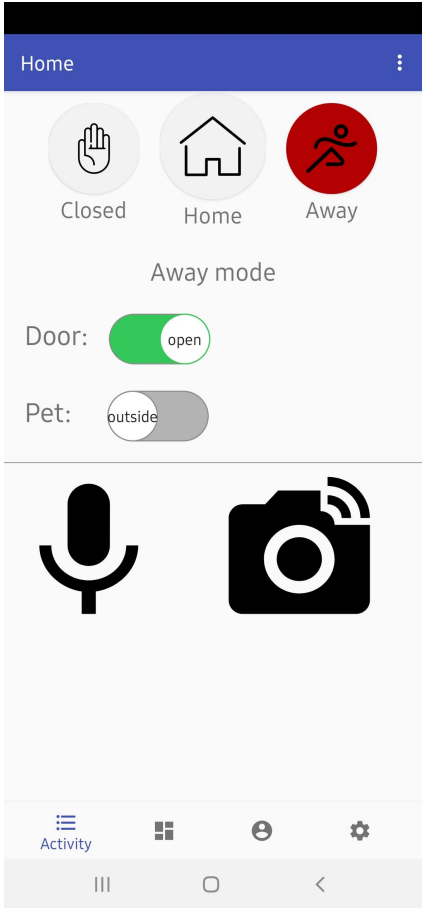


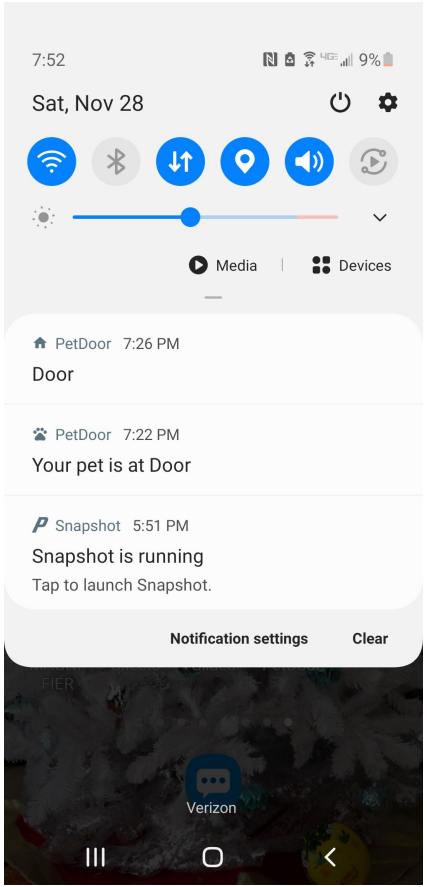


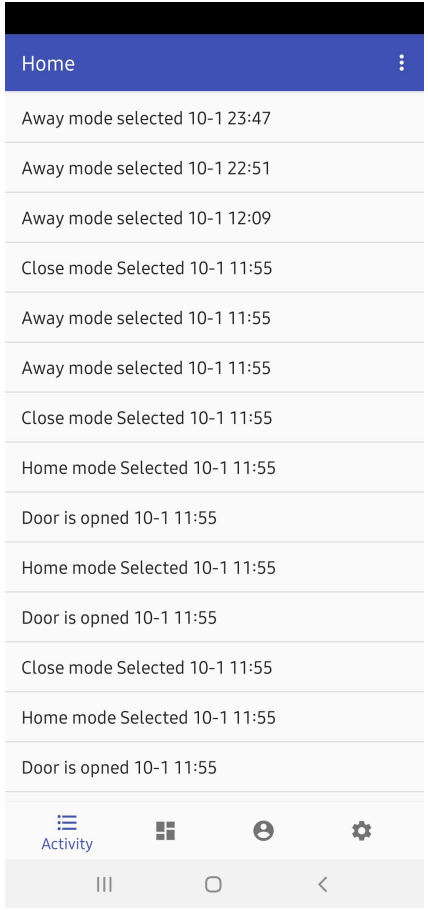


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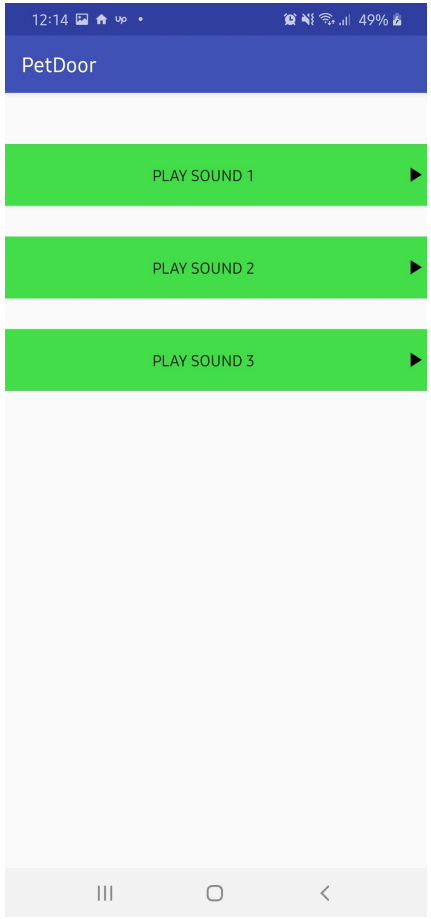


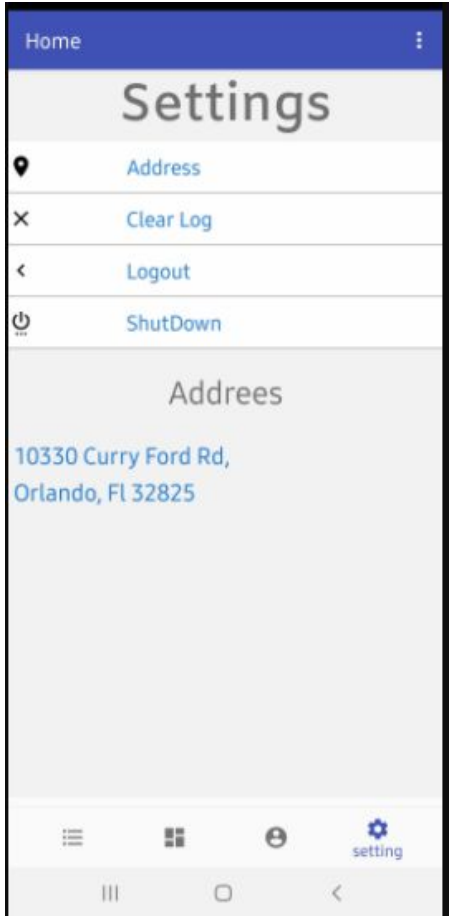



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# Application Testing

- Test Case 1: Check Result on entering valid User Id & Password
- Test Case 2: Check Result on entering invalid User Id & Password
- Test Case 3:  Check response when Login, Mode, and Door button are pressed.
- Test case 4: Check notification response when Away mode is selected and pet is detected.
- Test case 5: Check result when camera / speaker icon is pressed
- Test case 6: Check result on activity screen if log history is generated

# Important Standards

PCB & Hardware
Communications

UCF

| Technology | Standard | Description |
|---|---|---|
| Soldering Specification | IPC J-STD-001 | Describes **materials, methods, and verification** criteria for a high quality solder connections |
| Printed Circuit Board Specification | IPC-A-610 | Describe acceptable methods for **hardware installation** on PCB assemblies |
| RoHs part components | 2002/95/EC | **Limit the use** of lead, mercury, cadmium, chromium (VI), PBBs, and PBDEs in electrical and electronic components. Effective as of July 1, 2006 |
| RFID | ISO/IEC 20248 | Automatic Identification and Data Capture Techniques – Data Structures – Digital Signature Meta Structure |
| WiFi | IEEE 802.11 | **Computer communication** in various **frequencies**, including 2.4 GHz, 5 GHz, 6 GHz, and 60 GHz frequency bands. |
| Data Transfer | HTTPS | Describes how **data being transferred** between the browser and website will be **encrypted and secured**. |

Graham CPE

# Relevant Design Constraints:

- Environmental - No emissions or pollutants created.
- Economic - Prototyping costs and end product MSRP.
- Social - Product will only appeal to consumers with indoor/outdoor pets.
- Ethical - Built to last, wireless data encryption.
- Health and Safety -
  - Follow related standards to reduce electrical hazards.
  - Redundancy checks / failsafes to prevent malfunctions.
    - Prevent door from closing on pet/owner.
    - Prevent unauthorized access to door controls.
    - Prevent unauthorized access to owners networks.



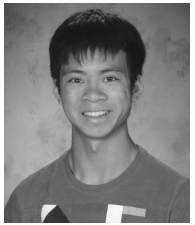
Graham CPE

# Work Distribution

| Responsibility | Power / Motor | Hardware / IO | Software Communications / Database | Software Mobile Development |
|---|---|---|---|---|
| Primary | Michael | Graham | Ryan | Joy |
| Secondary | Graham | Michael | Joy | Ryan |

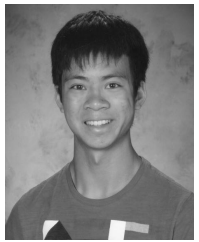
# Budget

| Part | Unit Cost | Quantity | Total |
|---|---|---|---|
| Raspberry Pi 4 Kit | $100 | 1 | $100 |
| Logitech Webcam | $40 | 1 | $40 |
| USB Speaker | $15 | 1 | $15 |
| Prototype Door Frame - Wood | $20 | 1 | $20 |
| Printed Circuit Board | $63.33 | 1 | $63.33 |
| Digikey Parts for PCB | $104.83 | 1 | $104.83 |
| Drok Dual H Bridge Motor Driver | $15.79 | 1 | $15.79 |
| 96W Power Supply Adapter | $17.99 | 1 | $17.99 |
| **Total** | | | **$376.94** |



Michael EE

# Thank you for participating in our project review committee!


Michael EE


Joy CPE


Ryan CPE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