University of Central Florida

PET CONNECT

Group 10 - Senior Design Fall 2020
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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.

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

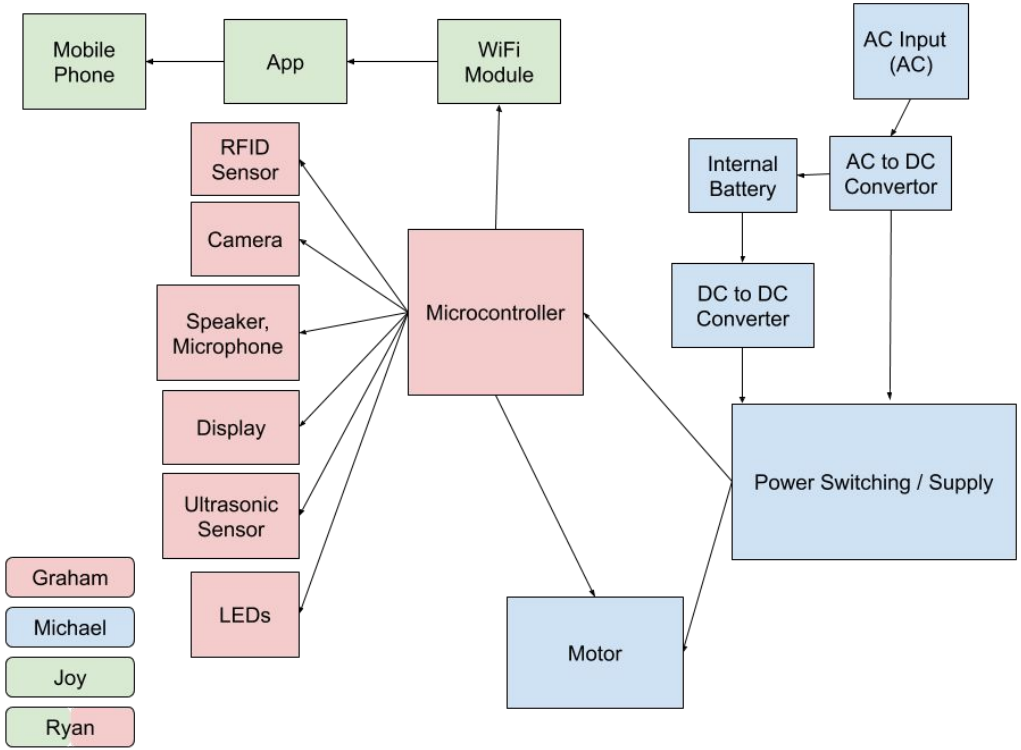
Goals and Objectives

- Create automated system to open, close, and lock 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.

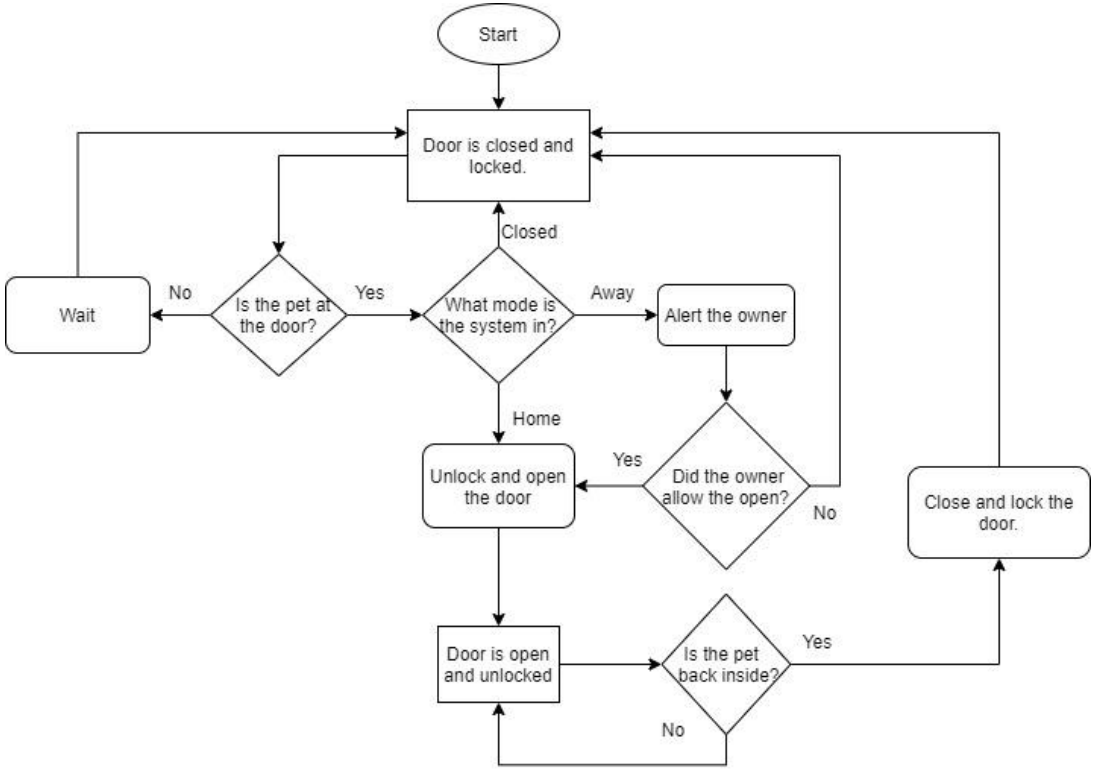
Specifications

Requirement	Description	Value
Power Usage	Power to operate the system	12 V
Sensor Range	Distance to verify the object	24” detection - Ultrasonic Sensor 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

Block Diagram



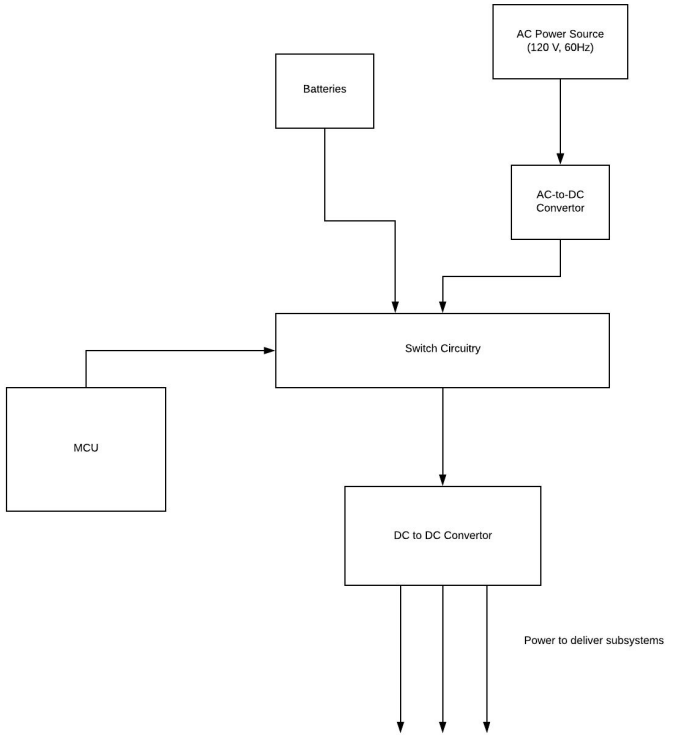
System Flowchart



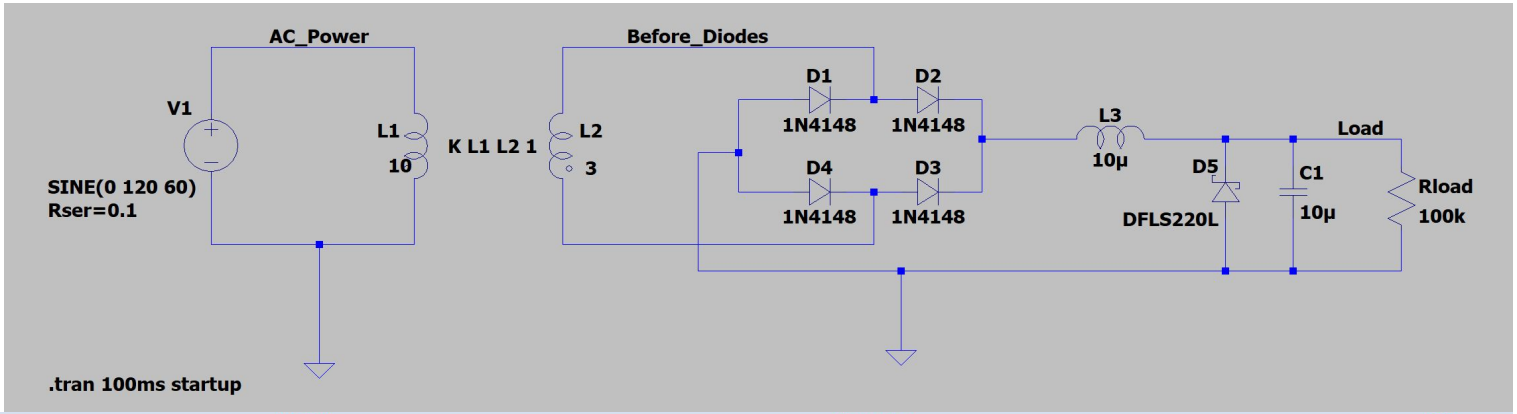
Power Block Diagram

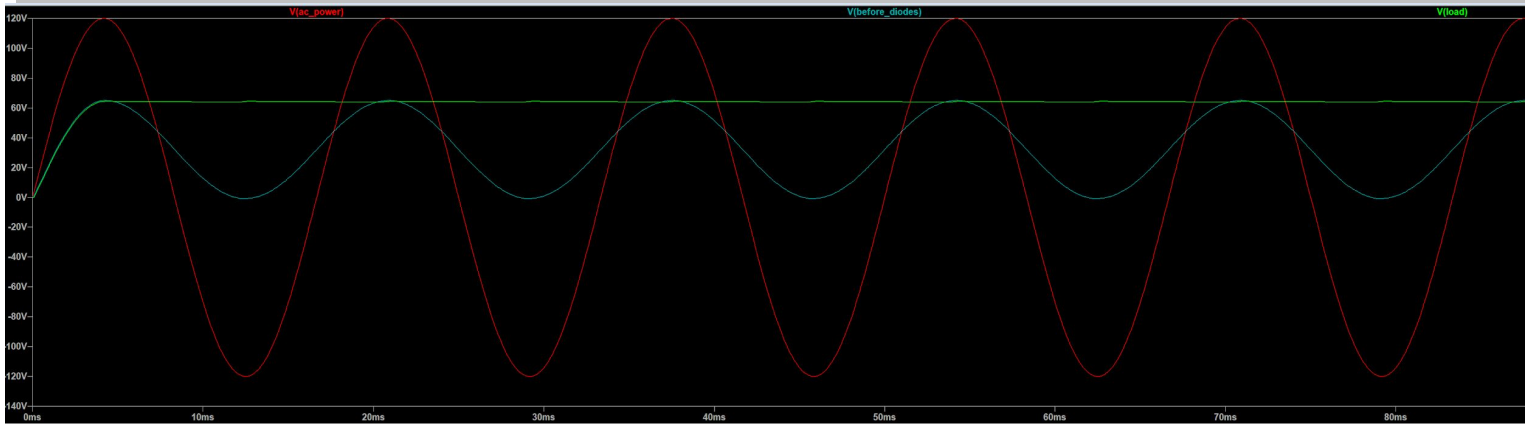
- Two Power Sources
  - AC wall outlet (120 V, 60 Hz)
  - Li-ion batteries

- DC to DC Convertor
  - Provide adequate voltage to subsystems
    - Motor/ Linear Actuator
    - Raspberry Pi
    - MCU



AC-DC Converter





Switch Circuitry - LTC4412

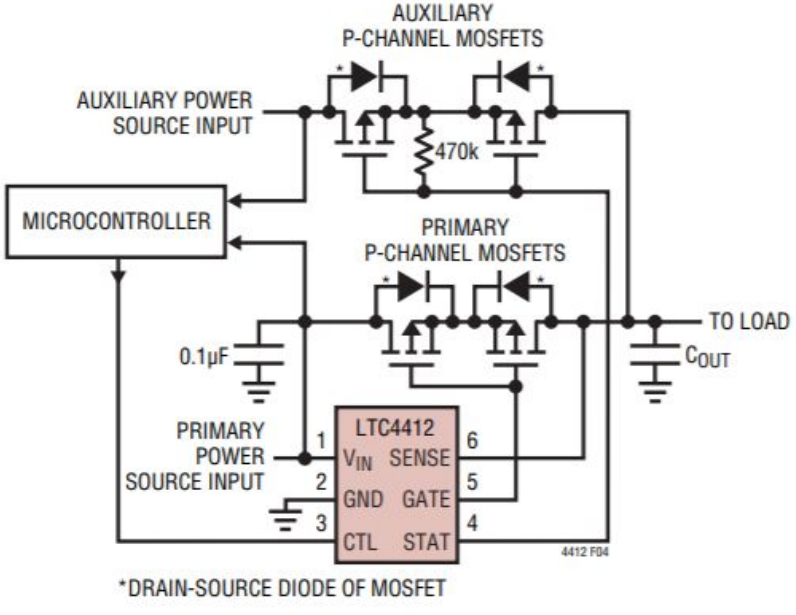
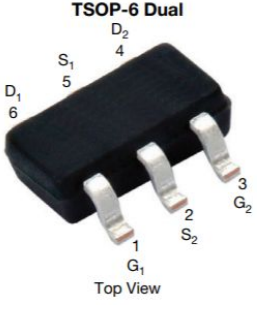


Figure 4. Microcontroller Monitoring and Control of Two Power Sources

- Control signal low -> primary power source
- Control signal high -> auxiliary power source

Automotive Dual P-Channel 30 V (D-S) 175 °C MOSFET



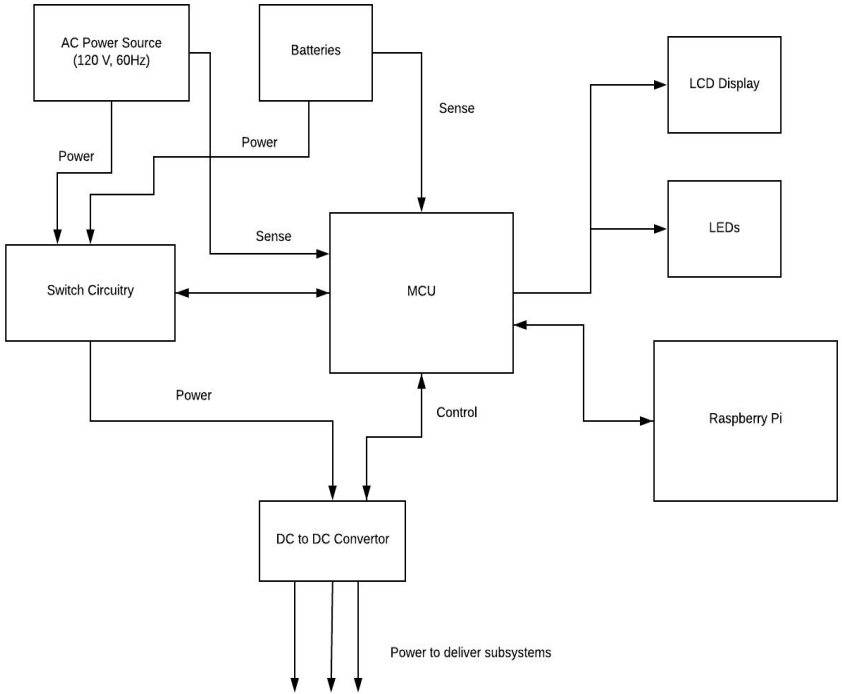
FEATURES

- TrenchFET® power MOSFET
- AEC-Q101 qualified
- 100 % R_g and UIS tested
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

MCU

Function:

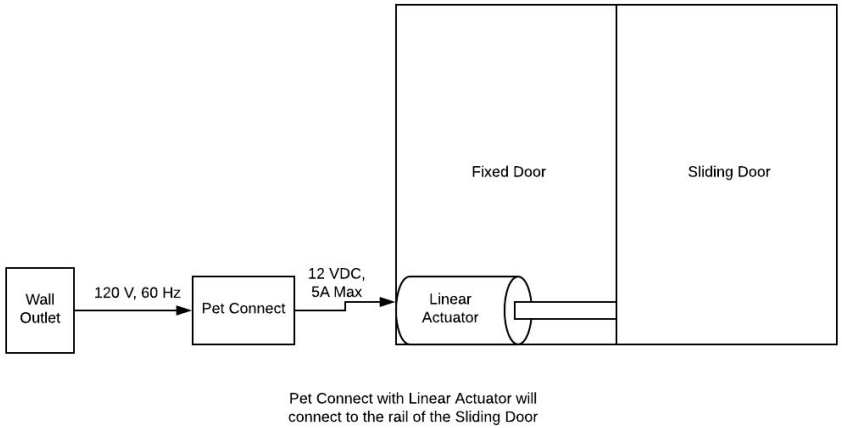
- control switch circuitry that will either draw power from AC wall outlet or Li-ion batteries
- direct power to subsystems
- Motor the voltage level of external Li-ion batteries
- will send message to Raspberry Pi, then to mobile application to indicate the user to replace batteries
- display status on LCD display
- light up LEDs



Linear Actuator

Classic Linear Actuator - Figelli Automations

- 12 VDC, 5 A Max
- strobe length - 24 inches
- 150 lbs of force at 0.5 inches per sec
- ~$130



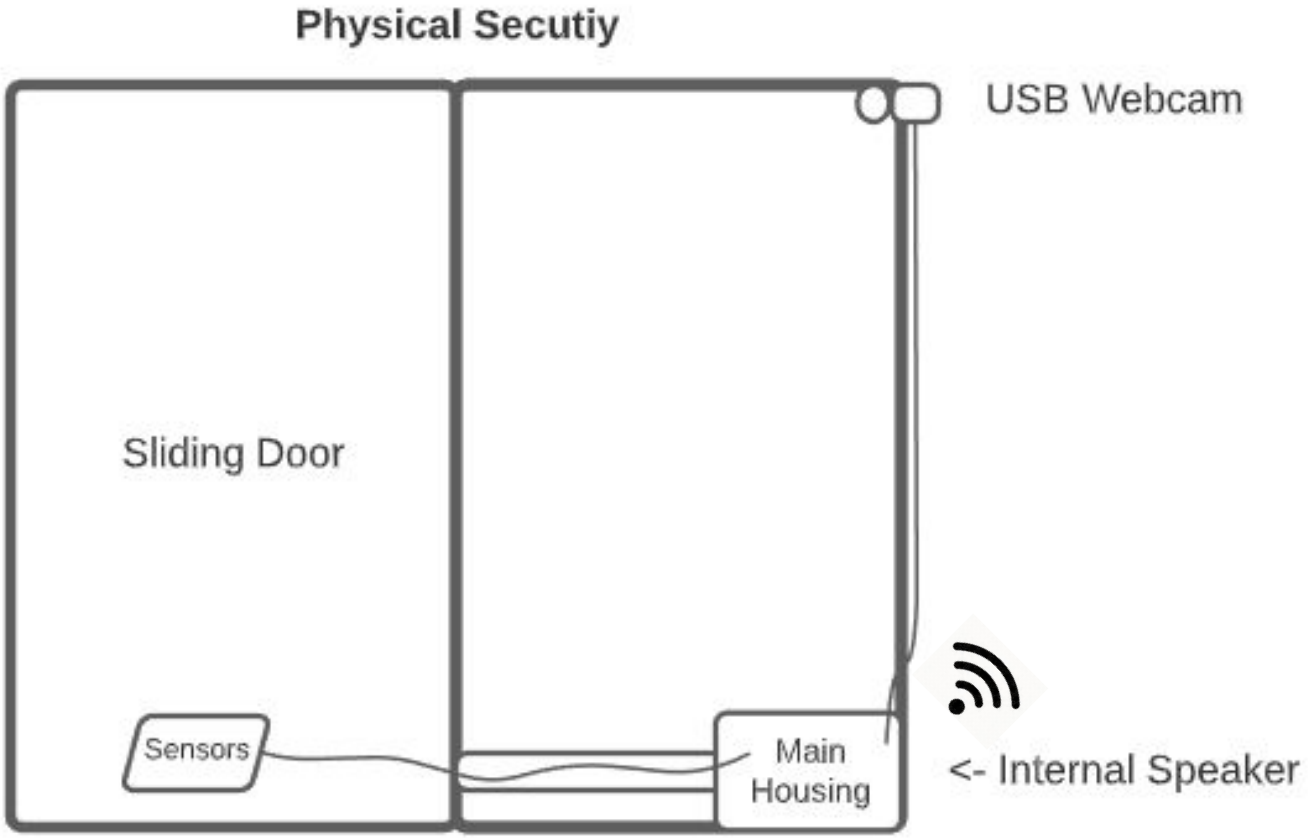
Pet Connect with Linear Actuator will connect to the rail of the Sliding Door

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

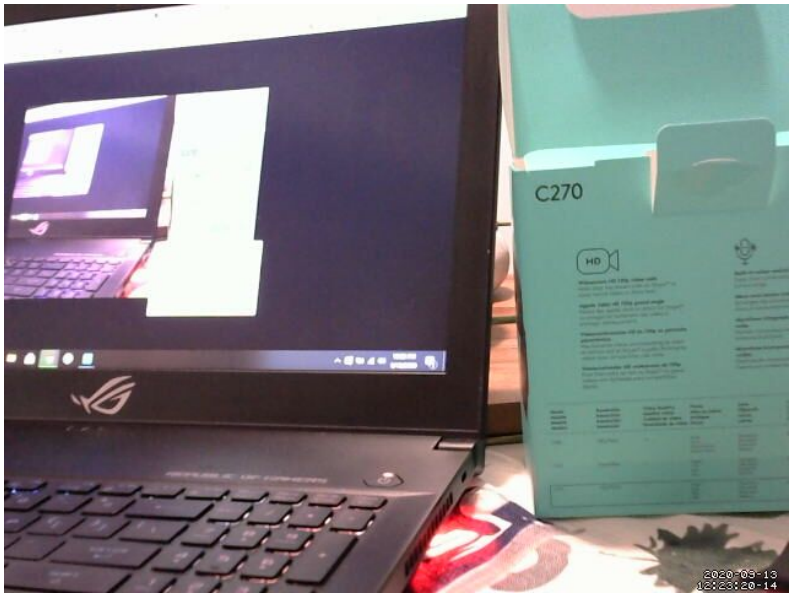
Design Approach - Physical Security



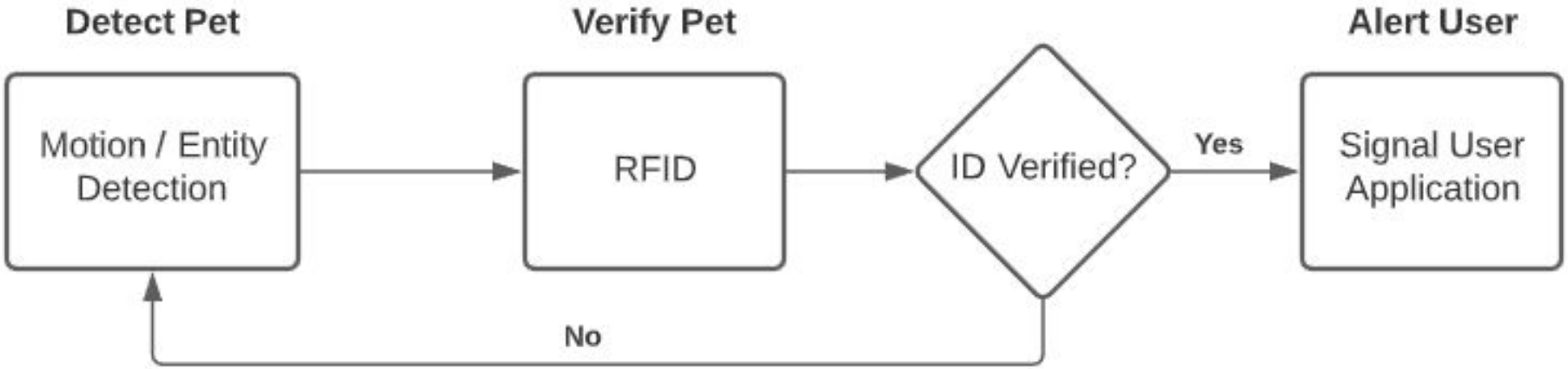
Logitech C270 / USB Speaker

- 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

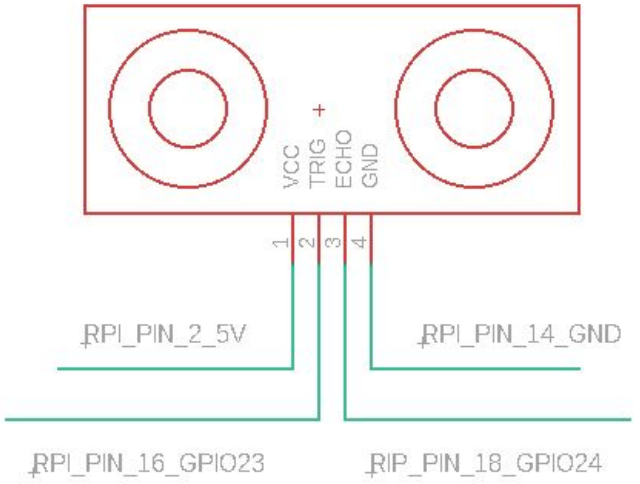


Design Approach - Sensing



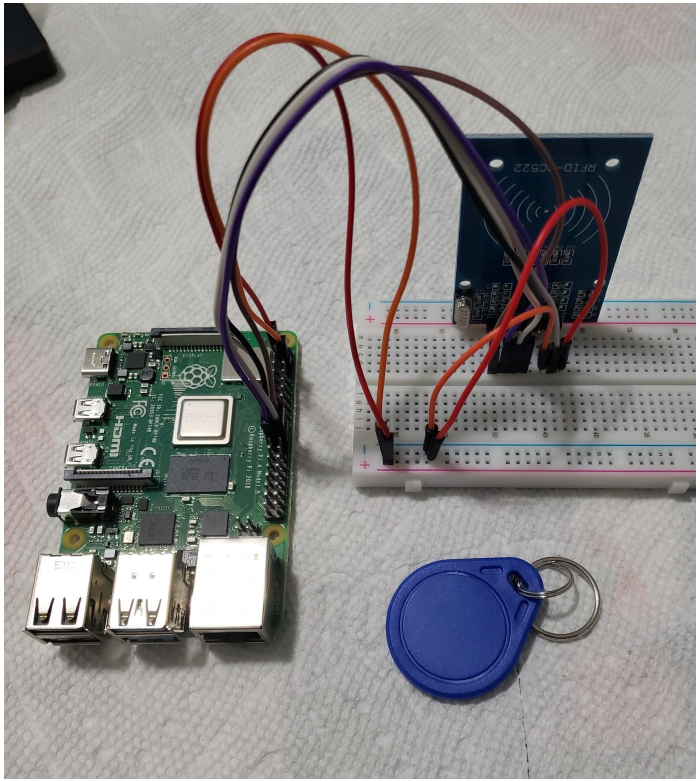
HC-SR04 Ultrasonic Sensor

- Measuring Distance: >450 cm
- Design Distance: <100 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

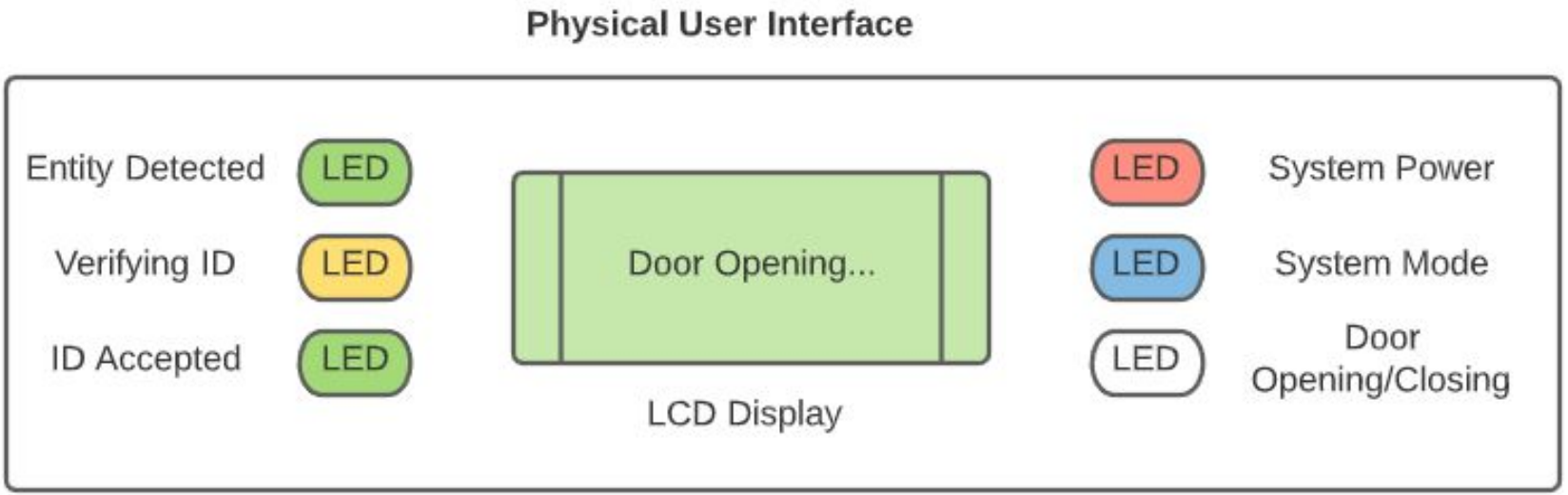


RC522 RFID Module

- 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

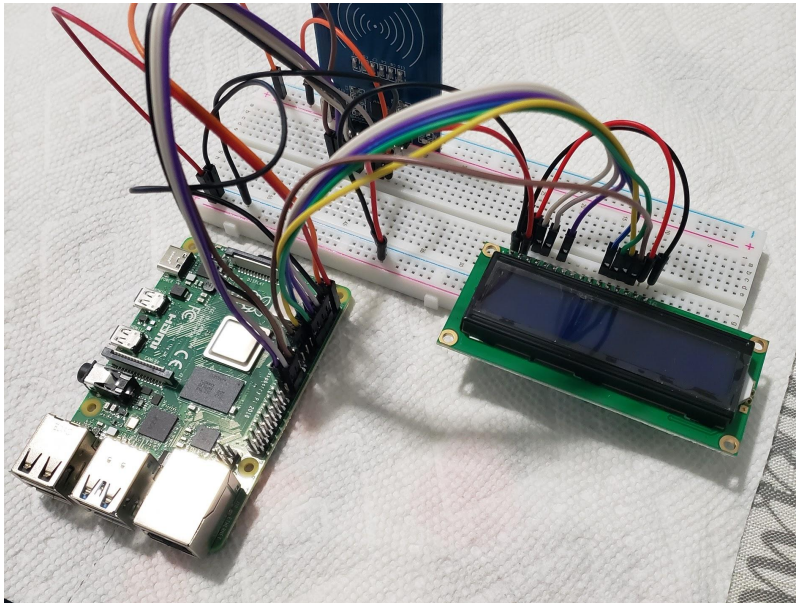


Design Approach - User Interface



LCD 1602

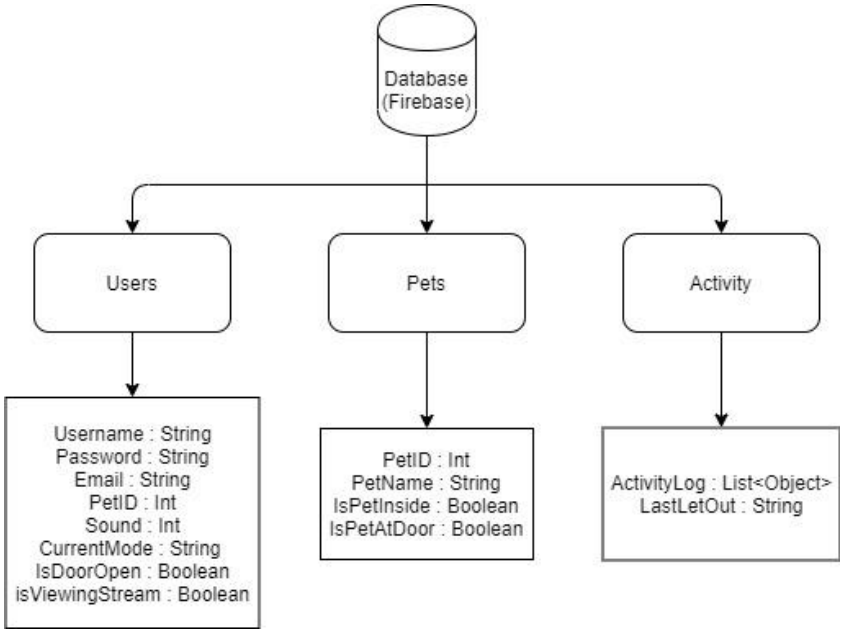
- Offers 16x2 character display
- 7 GPIO, 5v, Gnd
- Experience using in Jr Design
- Used to display active operation
- Size offers big enough screen while small enough to fit on housing
- Free - already owned



Software Overview

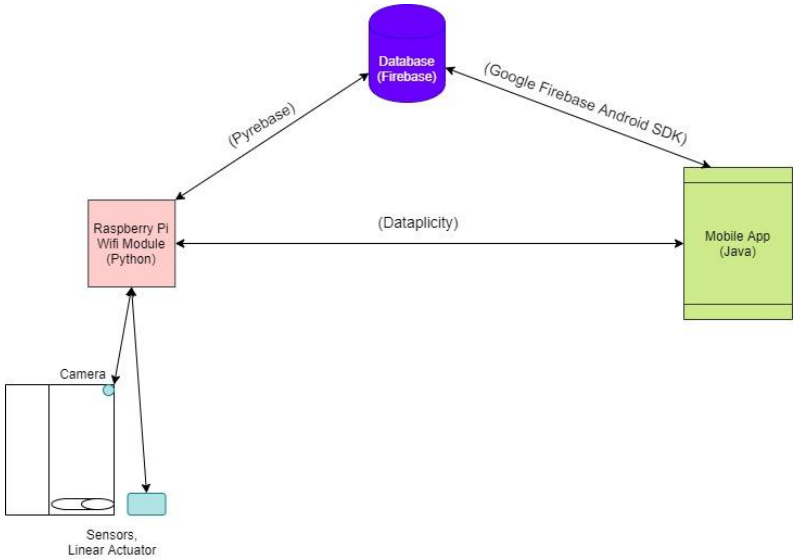
Realtime Database

- 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.

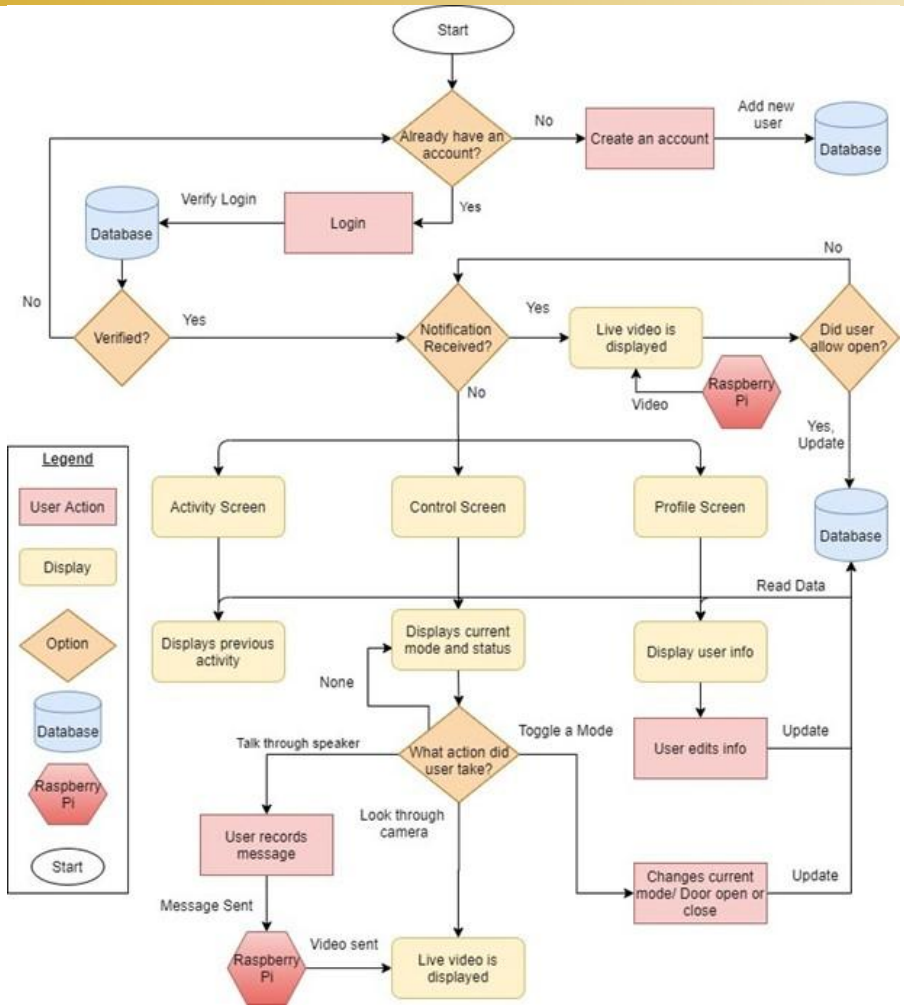


Wireless Communication

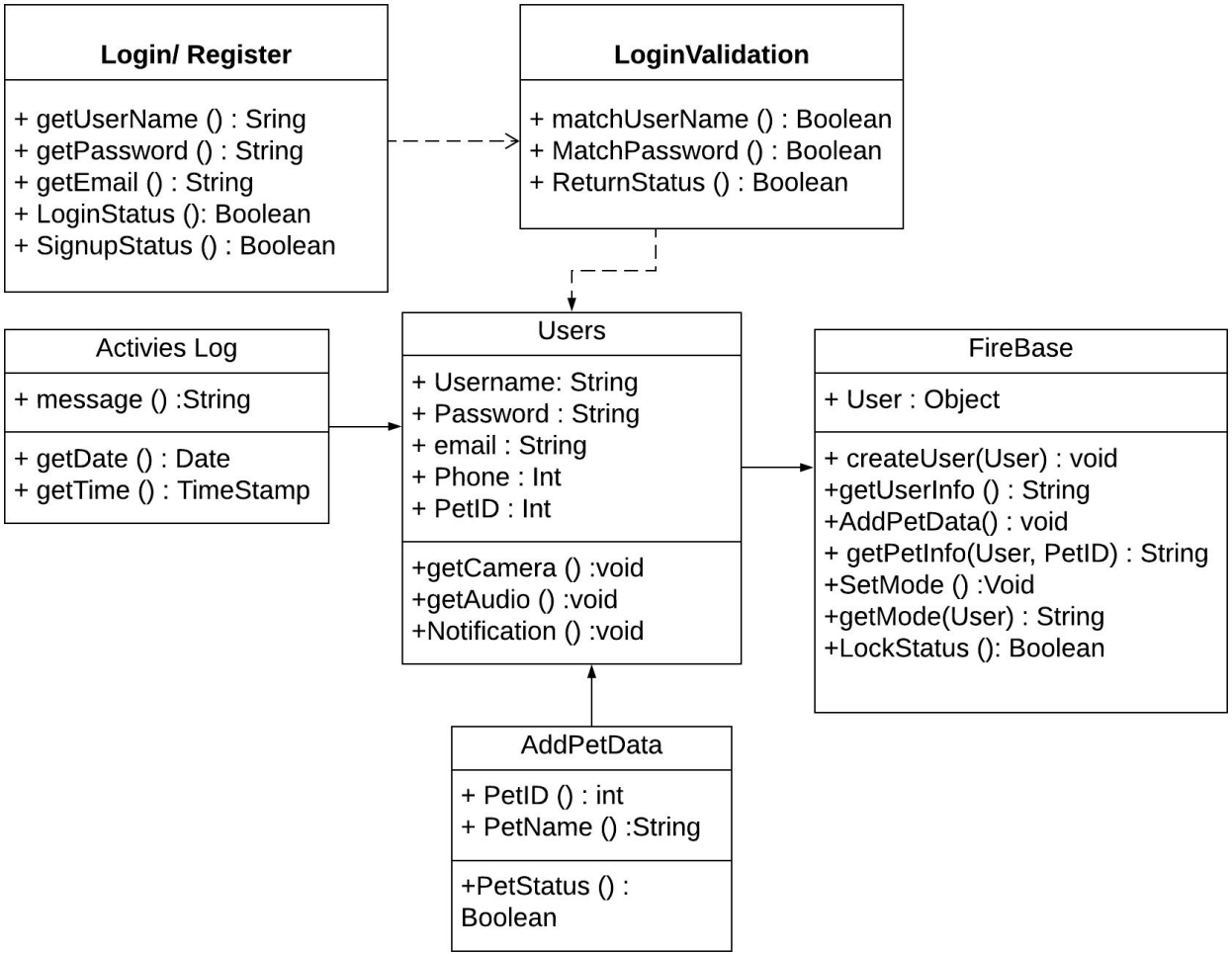
- Firebase Android SDK and Pyrebase to interact with the database.
- Live Video Streaming with
  - Dataplicity
  - Port Forwarding the Raspberry Pi.



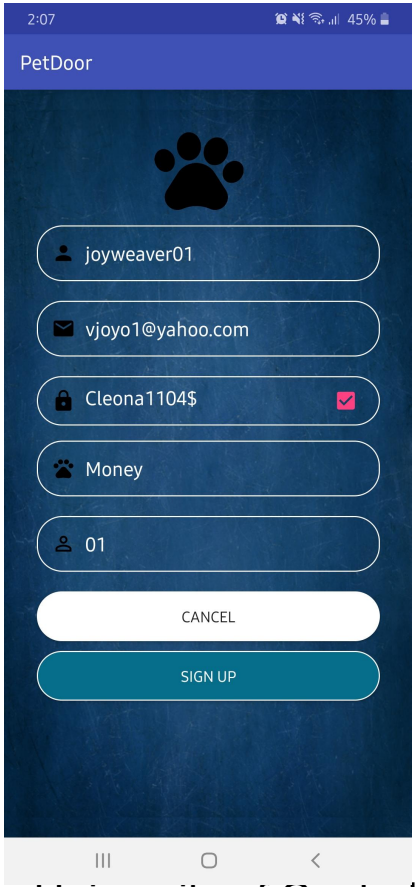
Mobile App Flowchart

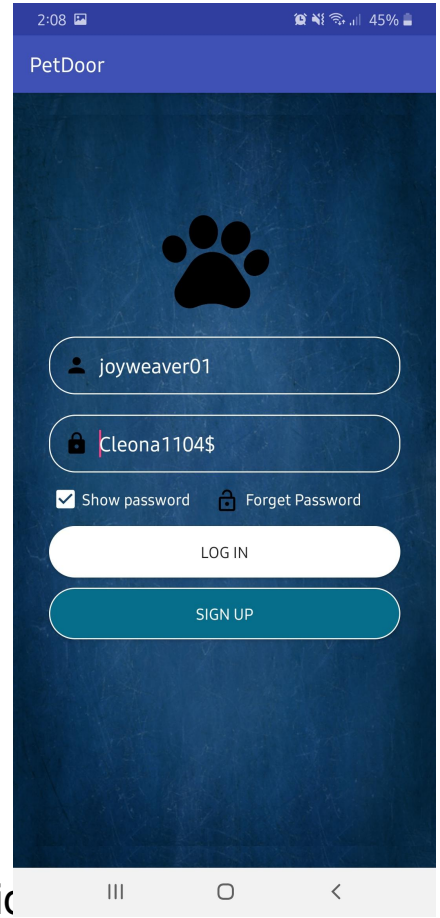


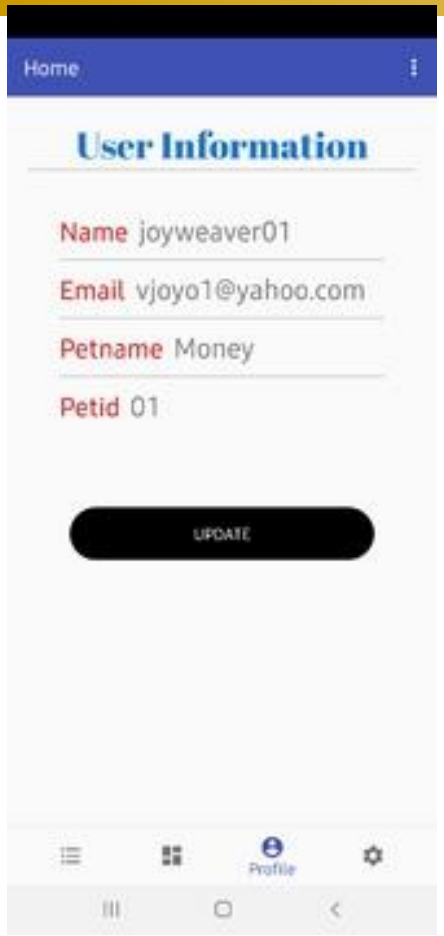
Class Diagram

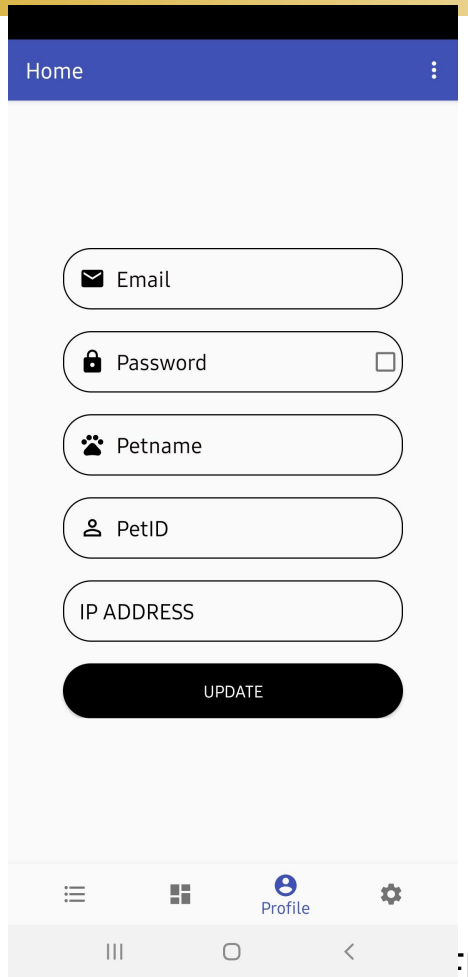


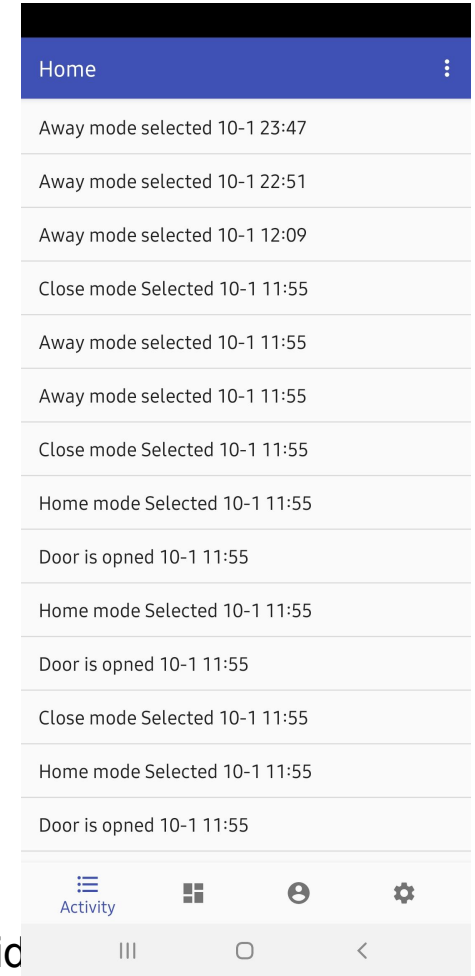

1:42
PetConnect

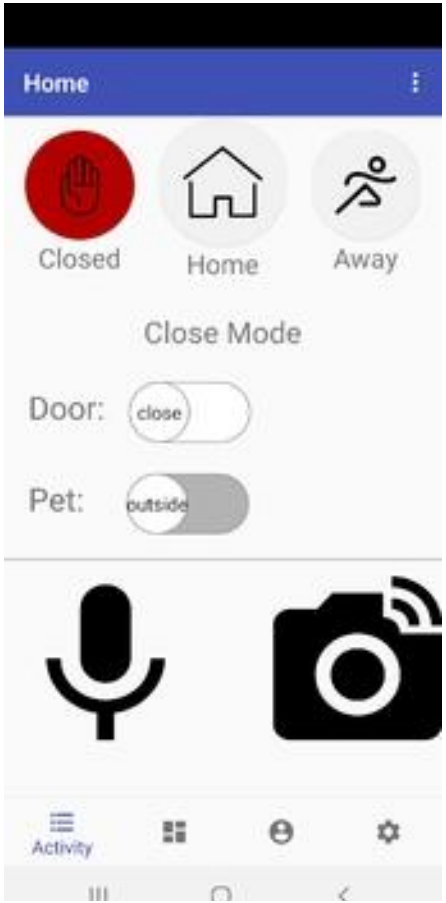

2:07
45%
PetDoor
joyweaver01
vjoyo1@yahoo.com
Cleona1104$
Money
01
CANCEL
SIGN UP

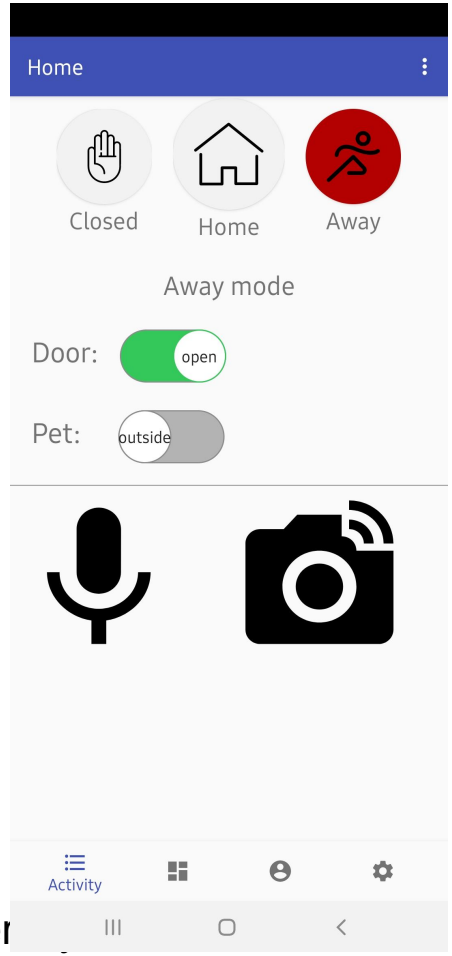

2:08
45%
PetDoor
joyweaver01
Cleona1104$
Show password
Forget Password
LOG IN
SIGN UP

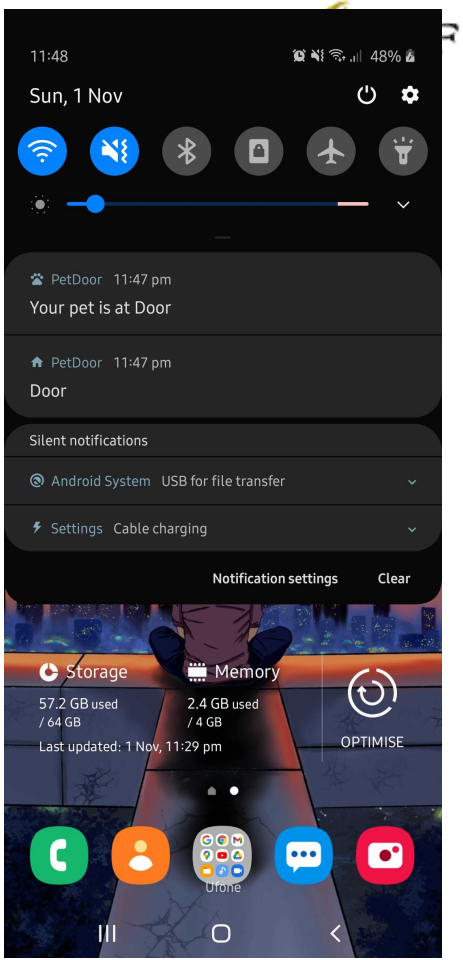

Home
User Information
Name joyweaver01
Email vjoyo1@yahoo.com
Petname Money
Petid 01
UPDATE
Profile


Home
Email
Password
Petname
PetID
IP ADDRESS
UPDATE
Profile

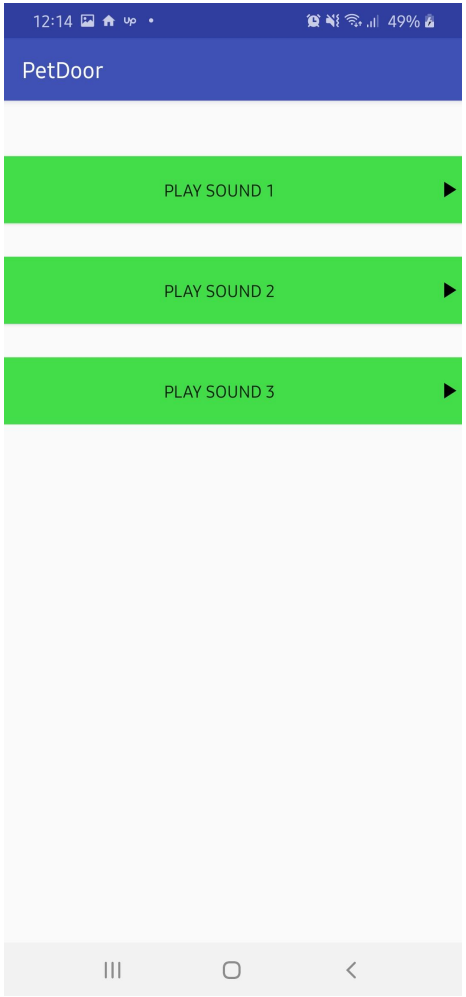

Home
Away mode selected 10-1 23:47
Away mode selected 10-1 22:51
Away mode selected 10-1 12:09
Close mode Selected 10-1 11:55
Away mode selected 10-1 11:55
Away mode selected 10-1 11:55
Close mode Selected 10-1 11:55
Home mode Selected 10-1 11:55
Door is opned 10-1 11:55
Home mode Selected 10-1 11:55
Door is opned 10-1 11:55
Close mode Selected 10-1 11:55
Home mode Selected 10-1 11:55
Door is opned 10-1 11:55
Activity

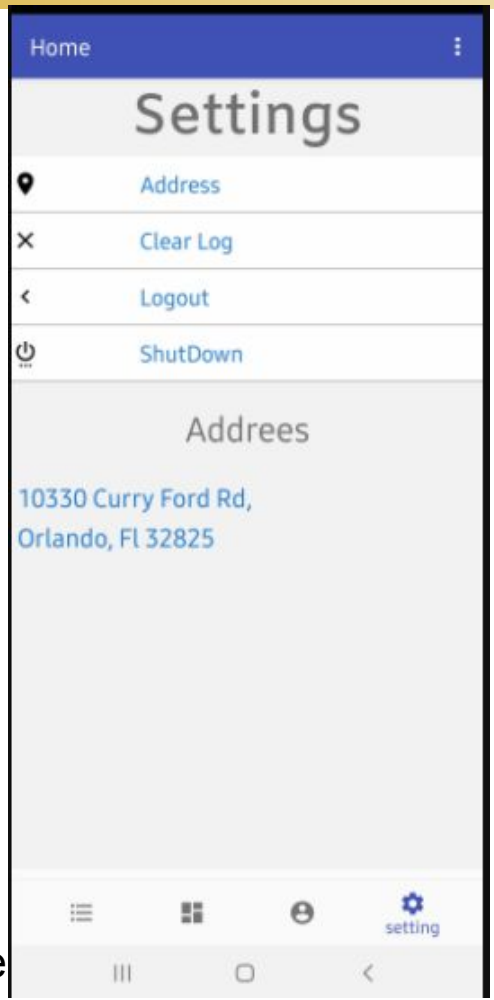

Home
Closed
Home
Away
Close Mode
Door:
close
Pet:
outside
Activity


Home
Closed
Home
Away
Away mode
Door:
open
Pet:
outside
Activity


11:48
48%
Sun, 1 Nov
PetDoor 11:47 pm
Your pet is at Door
PetDoor 11:47 pm
Door
Silent notifications
Android System USB for file transfer
Settings Cable charging
Notification settings
Clear
Storage
57.2 GB used
/ 64 GB
Memory
2.4 GB used
/ 4 GB
Last updated: 1 Nov, 11:29 pm
OPTIMISE

Univer


12:14
49%
PetDoor
PLAY SOUND 1
PLAY SOUND 2
PLAY SOUND 3


Home
Settings
Address
Clear Log
Logout
ShutDown
Addrees
10330 Curry Ford Rd,
Orlando, Fl 32825
setting


12:05
50%
PetDoor
Cypress Pavilion Pkwy
Doriath Cir
Stone Glen Dr
Curpin Ln
Cypress Knee Cir
Cribble Ct
RaceTrac
Curry Ford Rd
Starbucks
Wendy's
Wawa
Publix Super Market
at Curry Ford Square
Lamberton Blvd
Young Pine Rd
Andover Point Cir
Holland Dr
Bellingham Dr
Natoma Way
Ian St
Natoma
Google

Unive

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**.

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 and PII.

Successes and Difficulties: Peripherals and Hardware

Successes

- Setting up RPi as Webcam server
- Initial testing for RFID and LCD
- All peripherals parts ordered or acquired

Difficulties

- PN5180 has been replaced with RC522 until able to get it working, resulting in less RFID sensor read range
- Power-monitor circuit from MCU to Raspberry Pi

Successes and Difficulties: Software

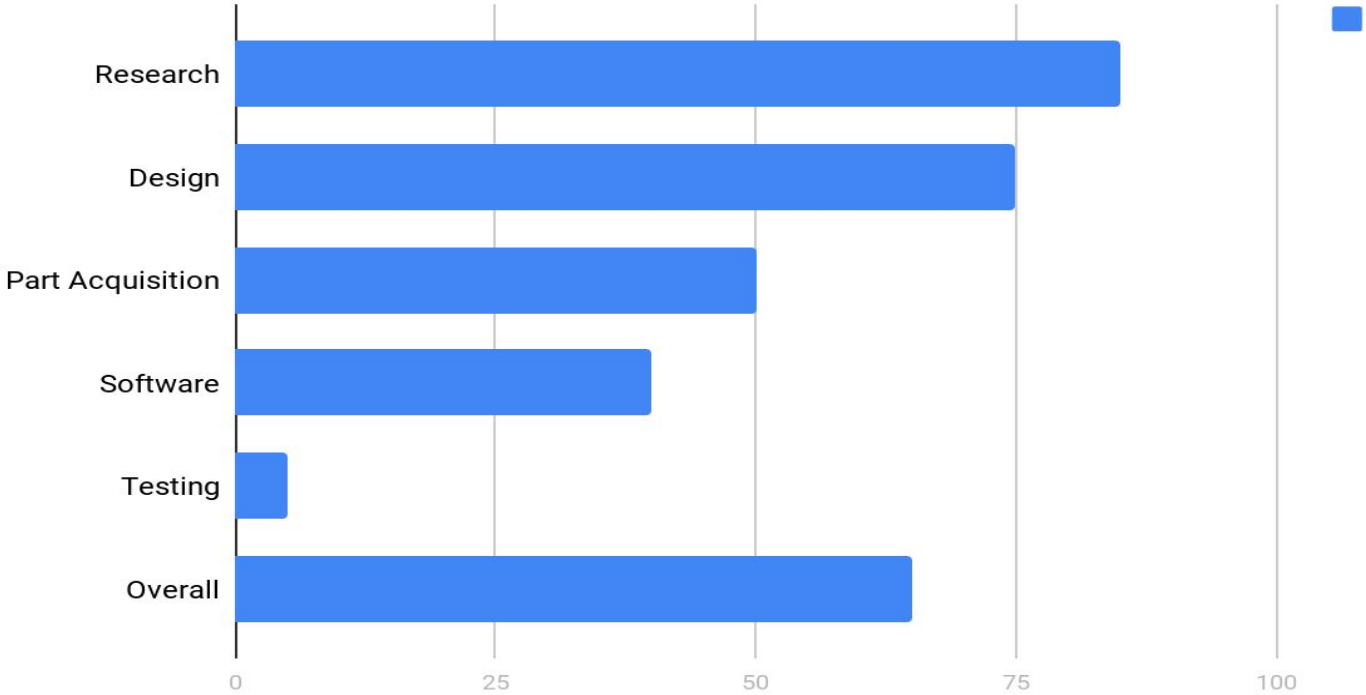
Successes

- User Interface development
- Login and Signup screens
- Database changes being recognized by the mobile app.

Difficulties

- How to determine the pet is back inside the house.
- How to best handle the audio messages that the user will send to the speaker.

Current Progress



Work Distribution

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

Schedule

Hardware Milestone

- Order PCB - 9/30
- Order Part - 9/30
- Initial PCB testing - 10/19

Firmware Milestone

- RPi communication with all peripherals working - 9/20
- Initial programming for RFID and Ultrasonic sensor - 9/30

Software Milestone

- First draft mobile app GUI - 9/30

Budget

Part	Unit Cost	Quantity	Total Cost
Raspberry Pi 4B	$100	1	**$100**
Ultrasonic Sensor	Owned	1	$0
RFID Module/Sensor	$12	1	$12
Part	Unit Cost	Quantity	Total Cost
Logitech Webcam	$40	1	**$40**
USB Speaker	$14	1	$14
LEDs	Owned	10	$0
1602 LCD Display	Owned	1	$0
PCB	$30	1	$30
Motor/Linear Actuator	$110	1	**$110**
Misc design parts	$100	-	**$100**
Totals	$406		$406

Questions?