HOMES

Home Observing and Monitoring Entry System

Group 12
Colleen Caffey - EE
Bruno Calabria - CpE
Ricardo Georges - EE

Motivation and Description

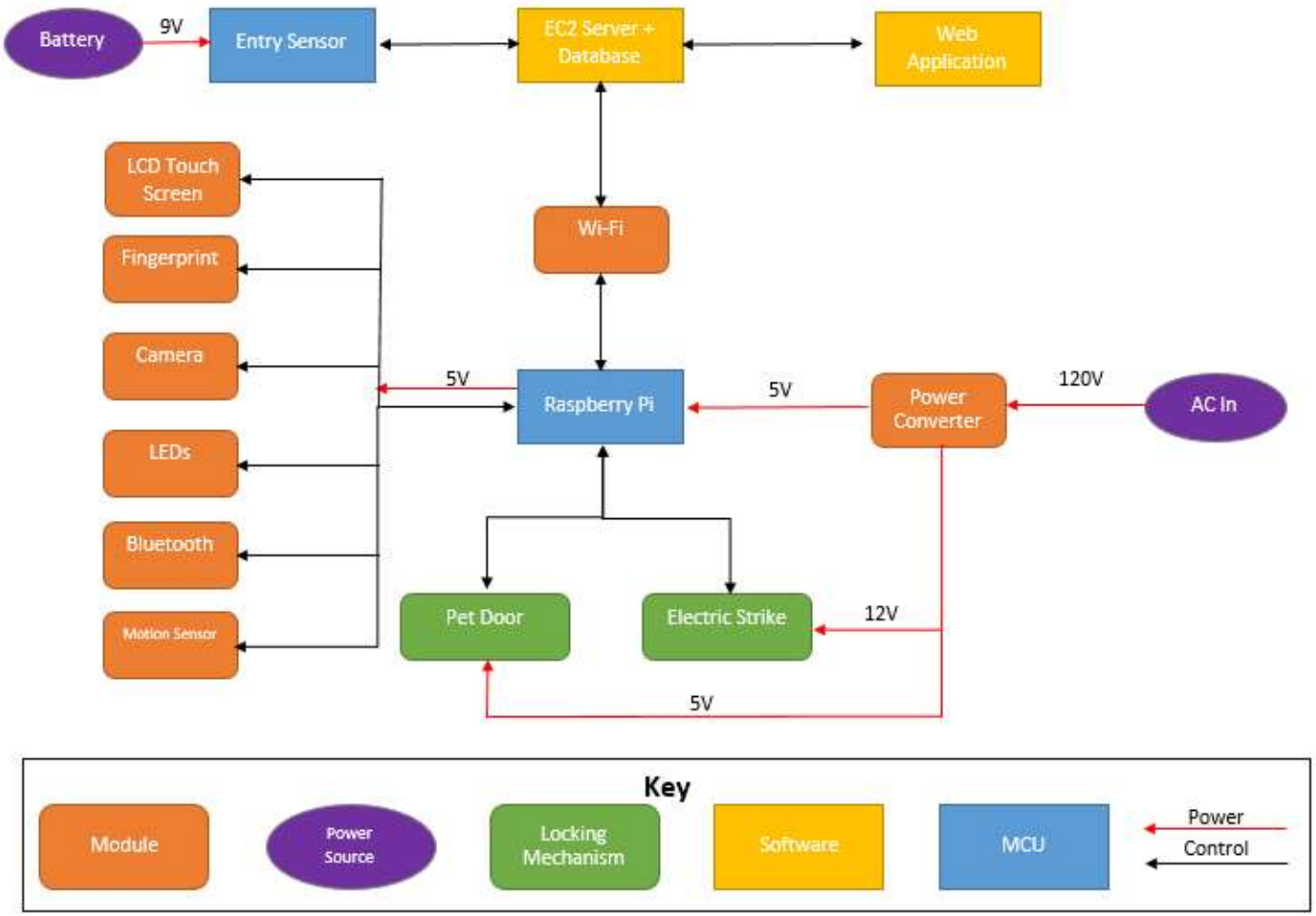
- Update the technology used to enter and monitor households
- Multiple ways to access home
- Monitor other entry points
- Pet door that unlocks itself
- Web application

Goals

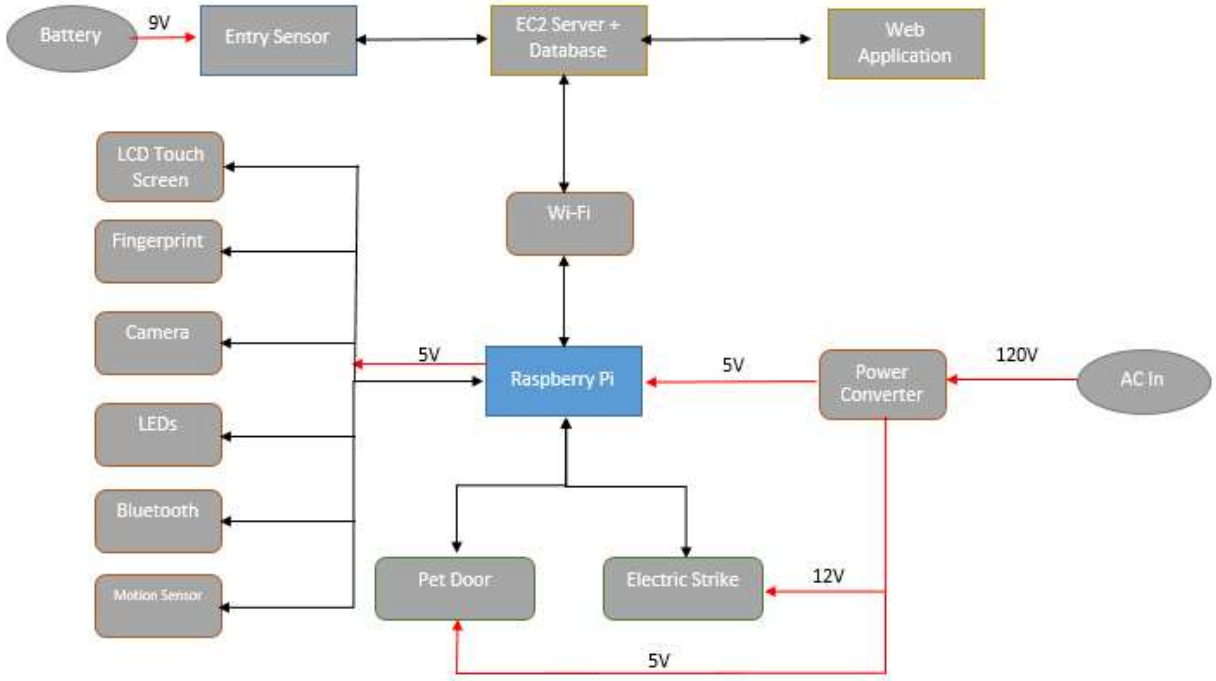
- Fully functional lock and unlock mechanism
- Motion sensor camera/light activation
- Detect the opening of entry points
- Have multiple ways to access home
- Pet collar wearable that unlocks pet door
- Fully functional web application

Specifications

Component	Desired Range or Value
Motion sensor	detect motion within 2 feet of door
Locking/unlocking mechanism	respond within 3 seconds of signal
Facial recognition	send success or fail signal within 30 seconds
Pet door	unlocks when pet is within 5 ft. from the door lock after wearable is out of range
External entry points	detect when opened within 1 second
Web application	update in real time


Battery
9V
Entry Sensor
EC2 Server + Database
Web Application
LCD Touch Screen
Fingerprint
Camera
LEDs
Bluetooth
Motion Sensor
Wi-Fi
5V
Raspberry Pi
5V
Power Converter
120V
AC In
Pet Door
Electric Strike
12V
5V
Key
Module
Power Source
Locking Mechanism
Software
MCU
Power
Control

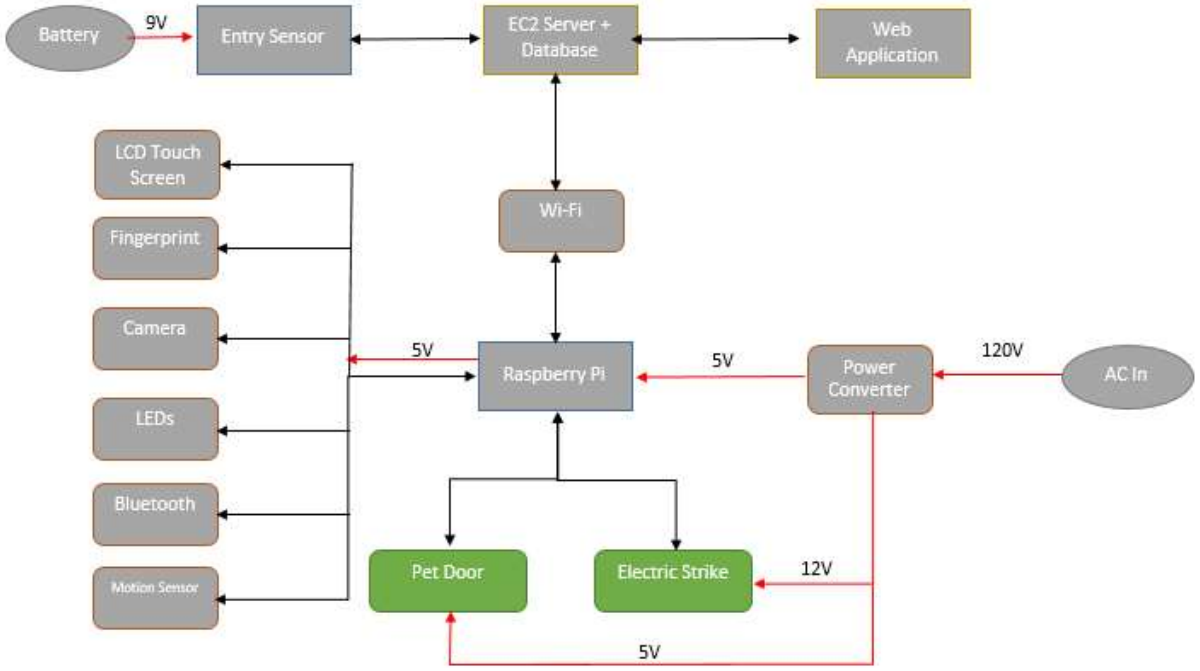
Single Board Computer



Our Choice

Specification	Raspberry Pi 2	Arduino Uno	Intel Edison	BeagleBone Black
CPU	Broadcom BCM2836 quad-core ARM Cortex-A7	Sitara AM3359AZCZ100 (ARM Cortex-A8	Intel Atom dual core 22nm SoC	TI Sitara™ AM3358 1GHz ARM® Cortex™- A8
Memory	1GB LPDDR2 SDRAM	2KB SRAM	1 GB LPDDR3 POP	512 DDR3L DRAM
GPIO pins	40	26	40	46
USB ports	4	0	2	1
Price	$35.00	$25.00	$75.00	$45.00

Locking Mechanism



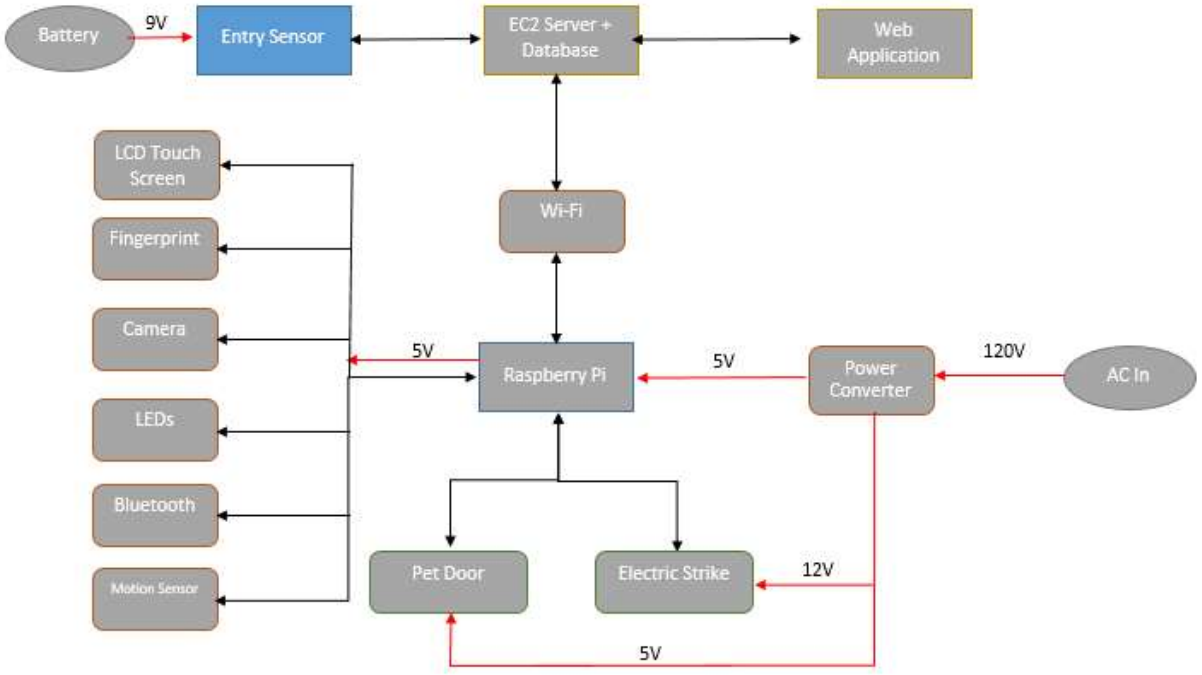
Electric Strike

- Fail Secure electric strike
- Will open with a 12V DC input
- Cheaper alternative than modifying an existing smart deadbolt
- More reliable than making our own locking mechanism

Pet Door

- Responds within 3 seconds of signal
- 6.25 in by 6.25 in
- Unlocks within 5 foot of door
- Locks after wearable is out of range
- Access via pet collar wearable

External Entry Points

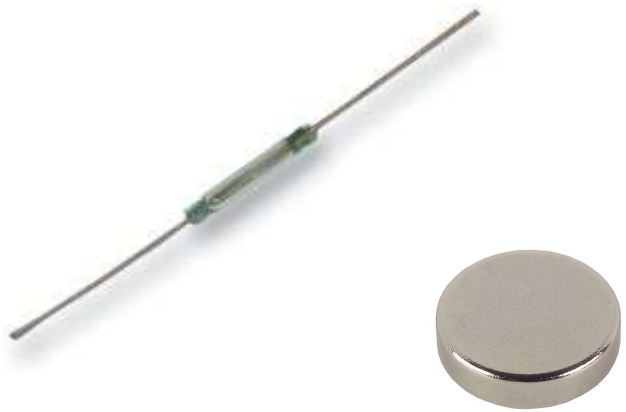


Sensors

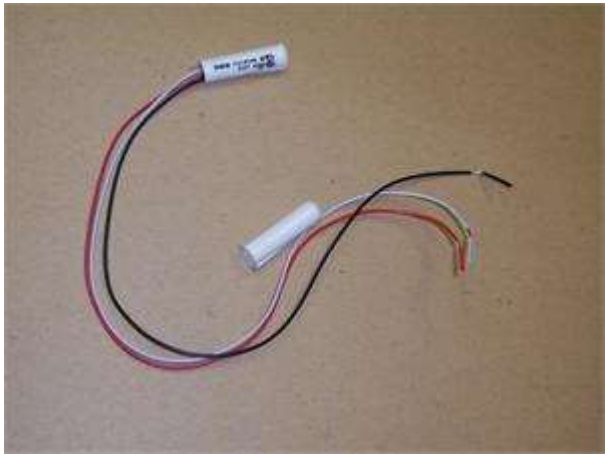
- Reed Switch
  - Open in absence of magnetic field
  - Closed in presence of magnetic field
- Displacement Sensor
  - Calculate the displacement
  - If the sensor has been moved then the displacement will be greater than zero
- Accelerometer
  - Measure the acceleration
  - If the entry point is being opened then there will be acceleration

Redesign

- Originally we used a reed switch and a magnet

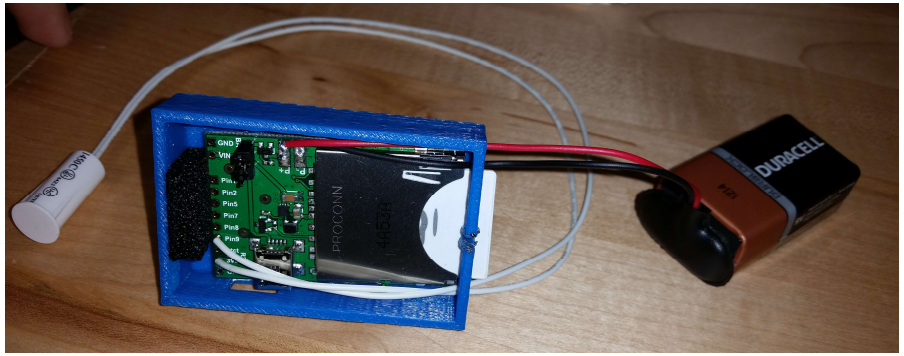


- Choose magnetic contact switch

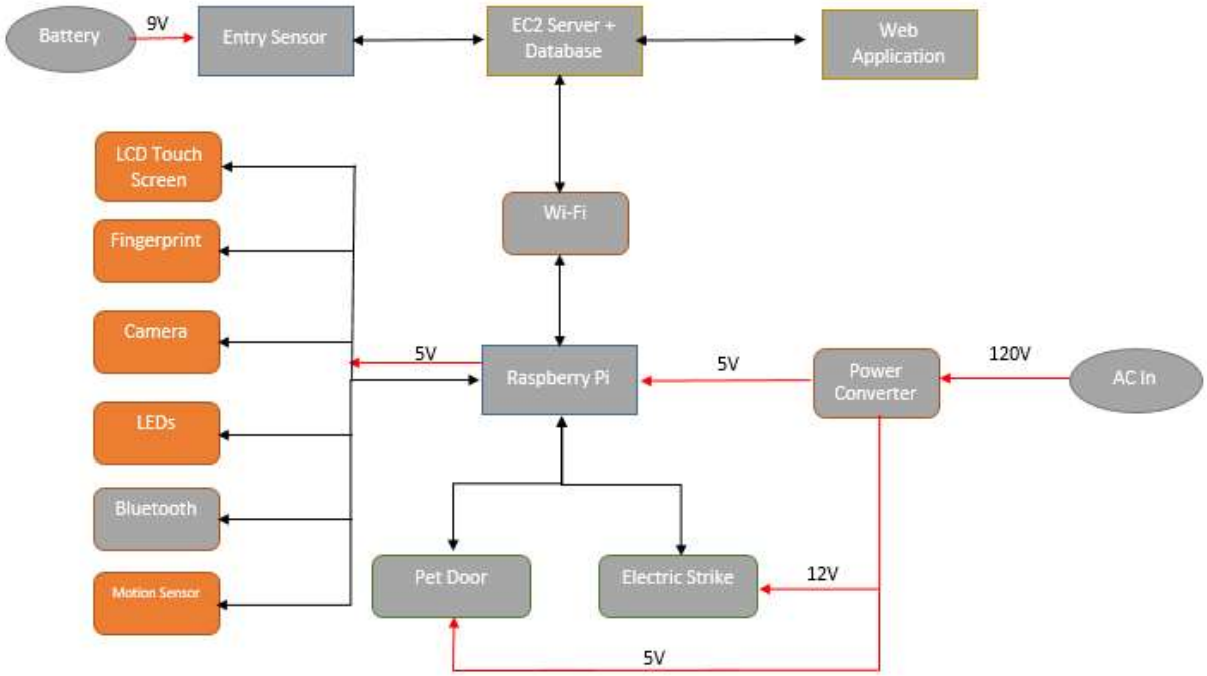


Finished Design

- Magnatic contact switch is normally open.
- Switch closes when a magnetic field is introduced.
- Imp listens for the pin to go high and records the time.



Modules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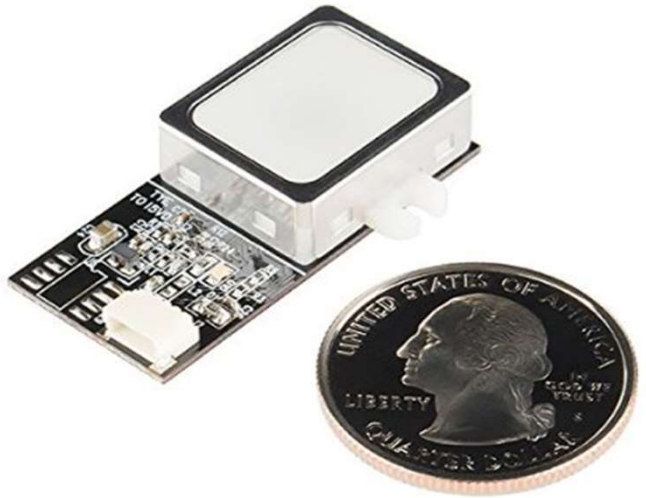
Pet Door
Electric Strike
12V
5V

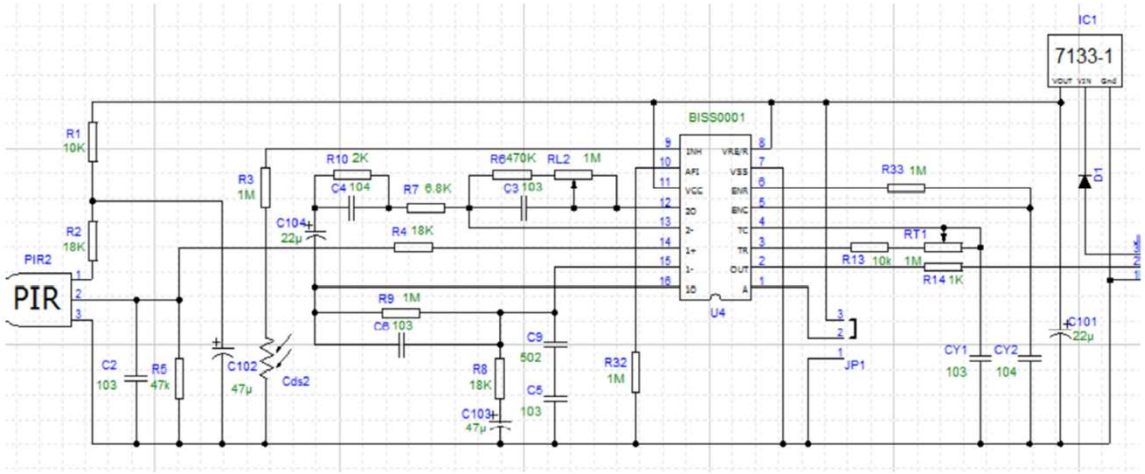
Fingerprint Scanner

TTL GT511C1R

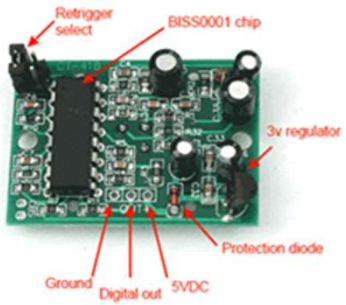
- 3.3 - 6 volt
- SmackFinger 3.0 algorithm
- R/W fingerprint templates and databases
- Simple UART protocol
- 360° recognition



Motion Sensor

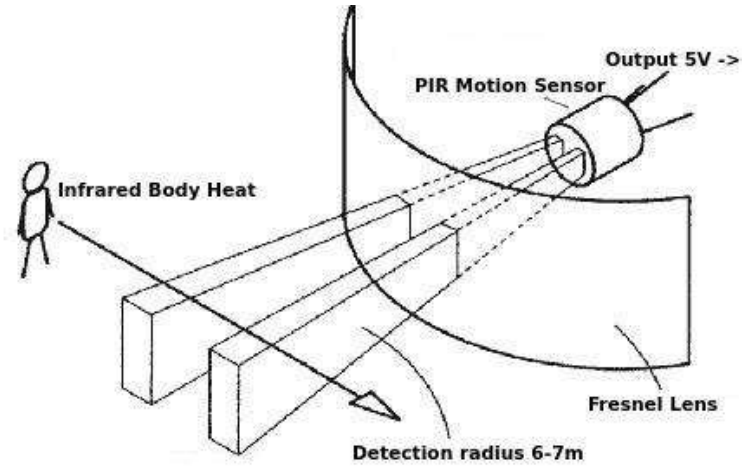


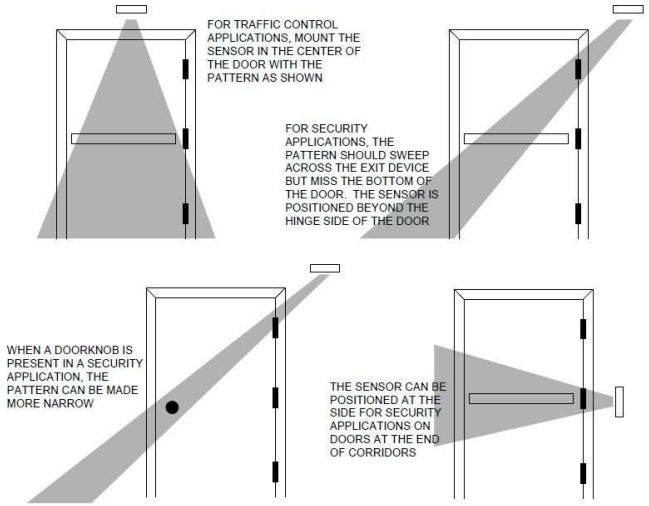
Datasheet HC-SR501



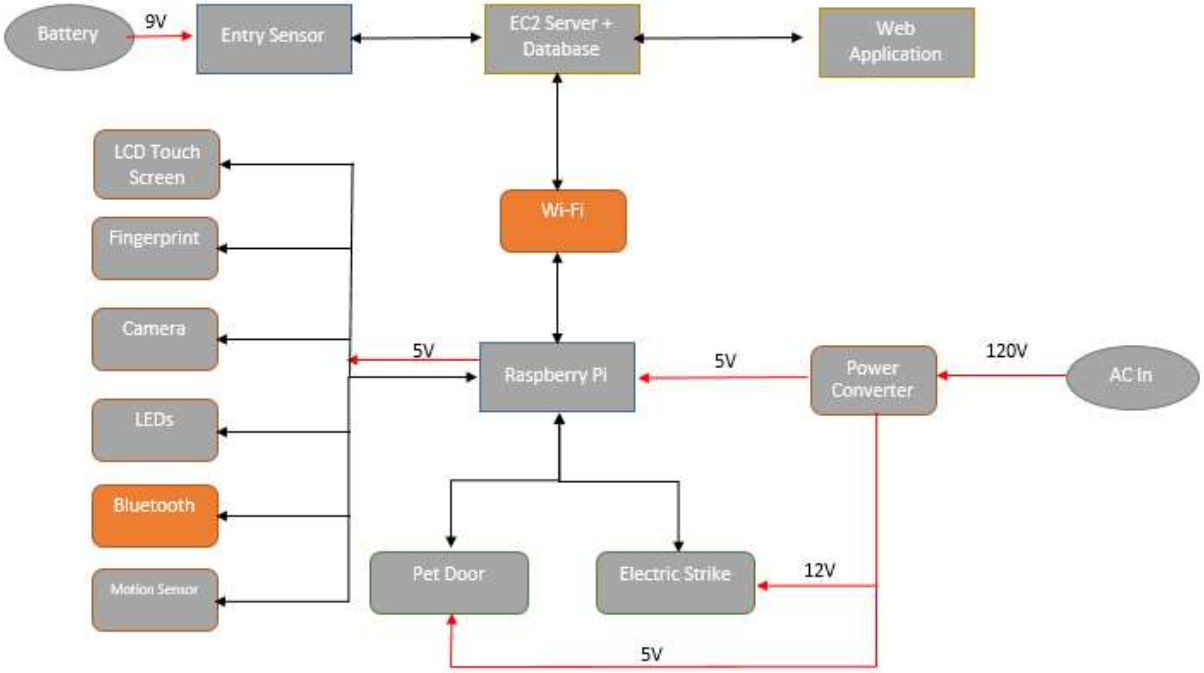
Vin: 5-20V
Vout: 0V Low / 3.3V High
Range: 20ft
Sensing Angle: 110°

Motion Sensor





Communications



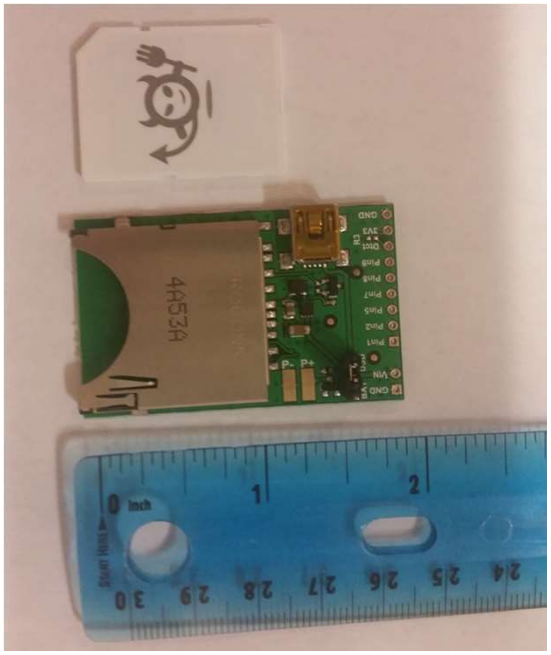
Comparison

Component	Bluetooth	Wi-Fi	ZigBee
Frequency	2.4 GHz	5 GHz	915 MHZ
Bandwidth	24 Mbits/s	6.93 Gbits/s	250 Kbits/s
Range	20-35 meters	10 meters	10-100

Wi-Fi Comparisons

- ESP 8266
  - Cheap.
  - Not well documented.
  - Hard to change configuration.
- TI CC3200
  - Free Sample, but dev board $30.
  - Documented, but very limited tutorials.
- Electric Imp
  - Dev board + Module $37.50.
  - Documented, tutorials, and more widely used.

Wi-Fi for Entry Sensor



Electric Imp with April Dev Board

- WEP, WPA and WPA2 encryption
- Cortex-M3 core
- Low power consumption
- 6 I/O pins
- Operate from any DC voltage from 3.3V to 17V
- Easy Setup

Bluetooth for Pet Collar

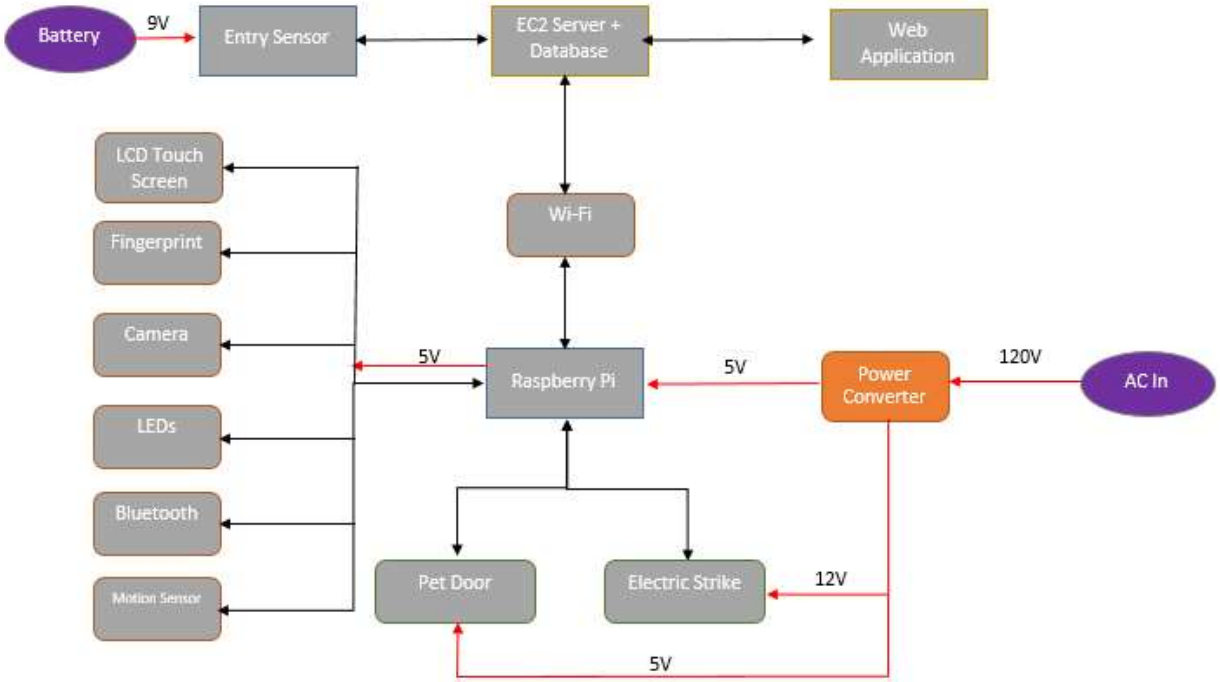
LightBlue Bean

- CR2032 coin cell battery
- Bluetooth 4.0 Low Energy
- 3V operating voltage
- 6 digital I/O pins, 2 analog pins
- Wireless programming

Bluetooth for Smart Phones

- Already had the Bluetooth adapter for the Raspberry Pi
- Most people have smart phones with Bluetooth capability
- Can be easily adapted to unlock the front door when an authorized user comes within range

System Power

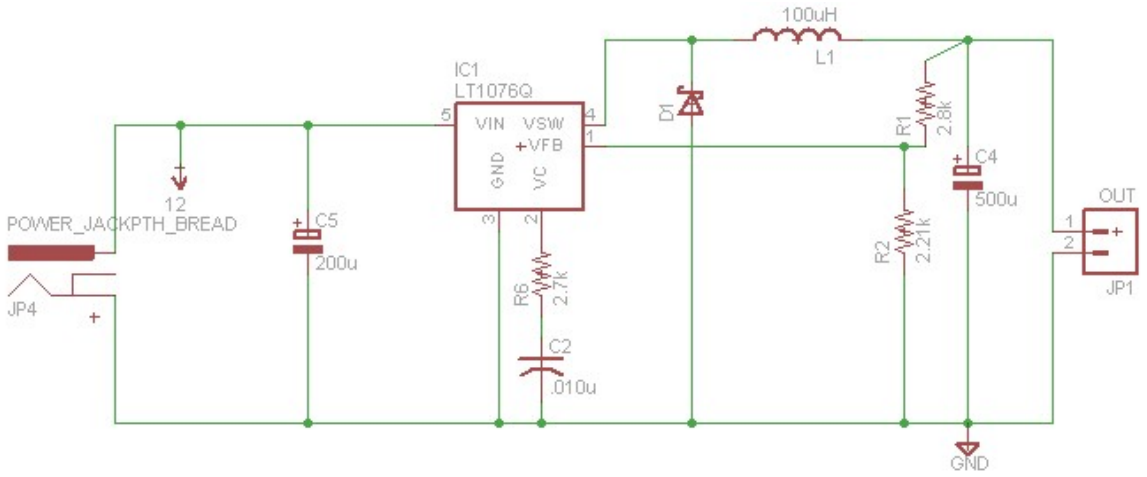


Entry System Power

- Electric imp needs 3.3 to 17V
- 9V battery with adapter
- 150 hours of battery life
- Easy to connect with electric imp

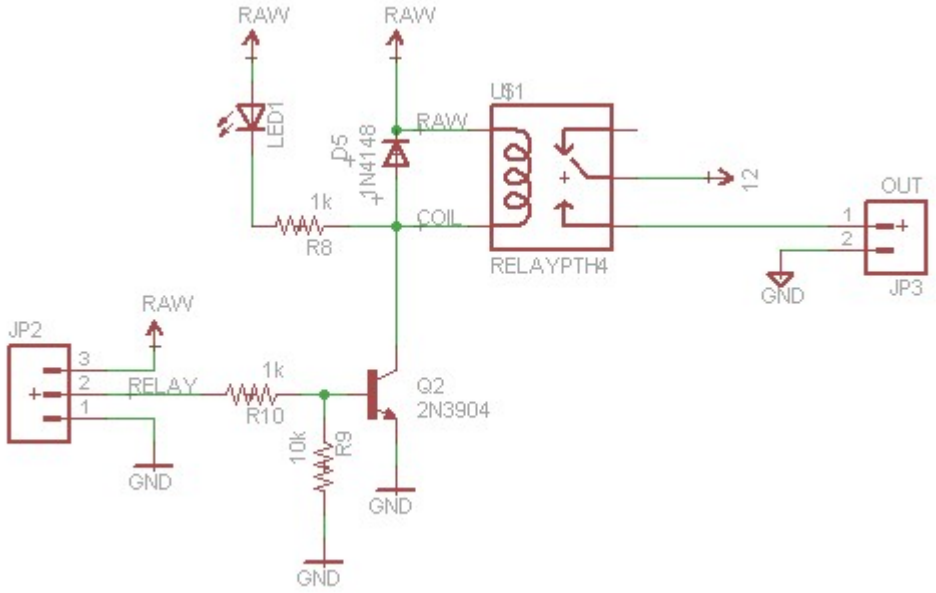
Main System Power

- Take 120VAC from wall outlet
- Use adapter to transform it to 12VDC
- Feed 12V to electric strike through relay
- Step town to 5V to power modules

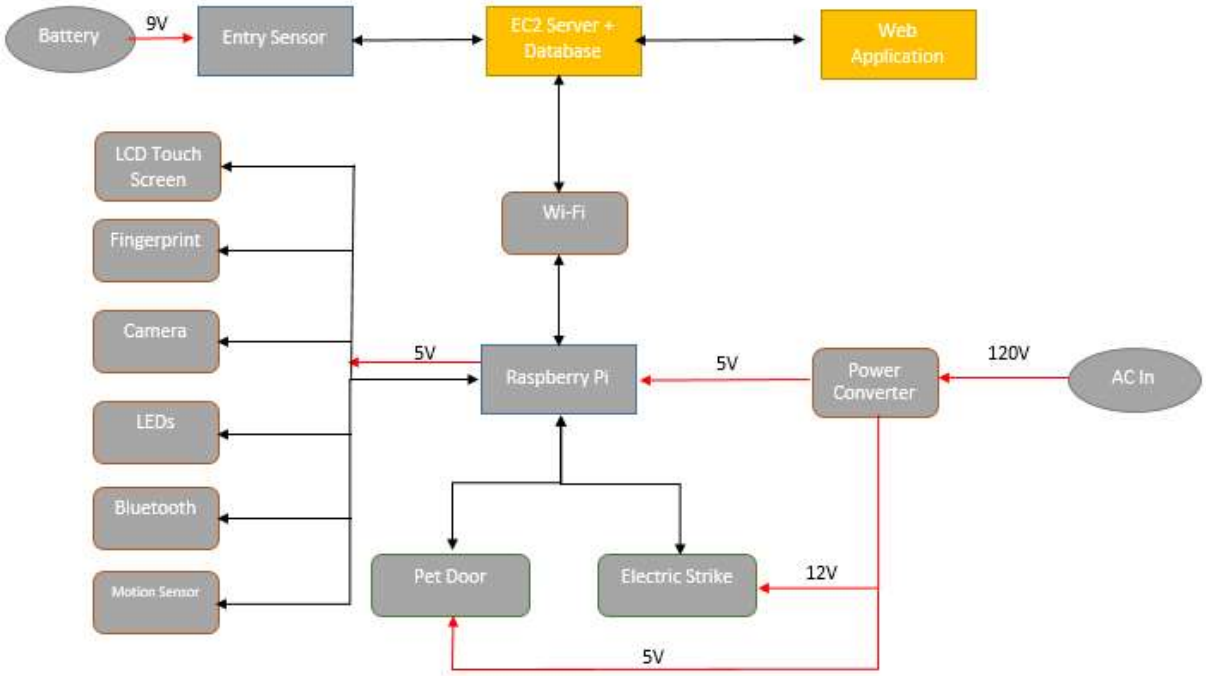


Relay Circuit

- Distributes 12V to the electric strike to unlock the door
- Pi gives signal to switch relay on
- Since strike is fail secure, it stays locked if no voltage is applied



Software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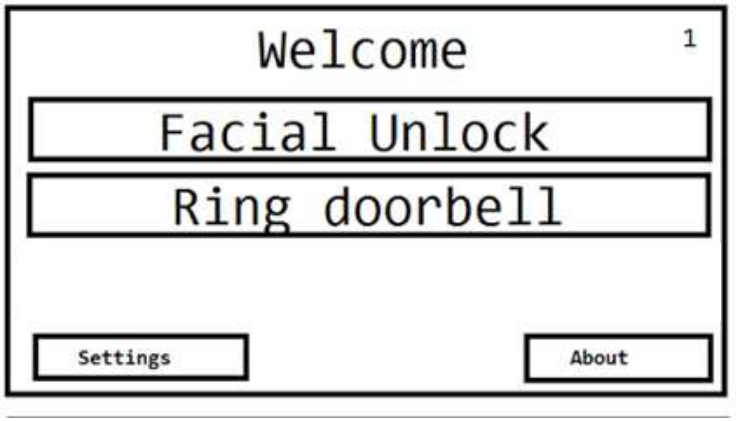
5V

Door Software

- Python
- Handling:
  - GUI
  - Facial Recognition
  - Bluetooth entry
  - Logging
  - Entry

Door User Interface

- How an outside user interacts with the system.
- Displayed on touch screen LCD.
- User can choose to:
  - Face recognition entry
  - Ring the owner



Facial Recognition

- Implemented in Python using OpenCV.
  - OpenCV FaceRecognizer class
    - Fisherfaces
  - Users will register new faces in admin console.
- Using a Logitech HDC310
  - Due to price and compatibility

Web App (FrontEnd)

Bootstrap 3.0

- Responsive design
- Cross-platform support

jQuery

- Most popular JS library
- Eleminates cross-browser incompalibilities

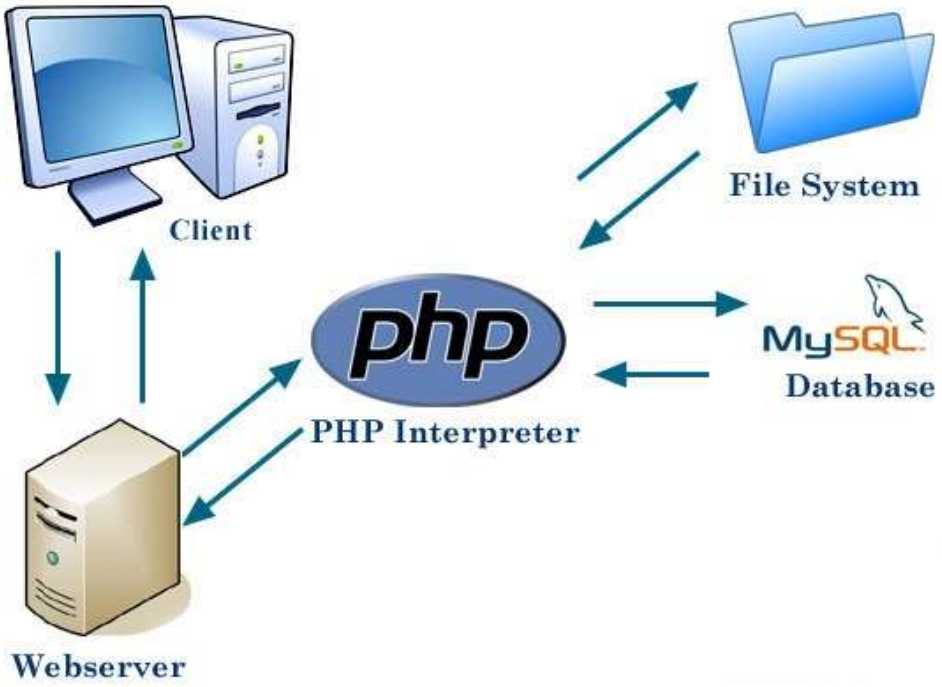
HTML5 + CSS3

- Page reformatiing
- Site-wide consistency

Web App (BackEnd)

PHP + MySql

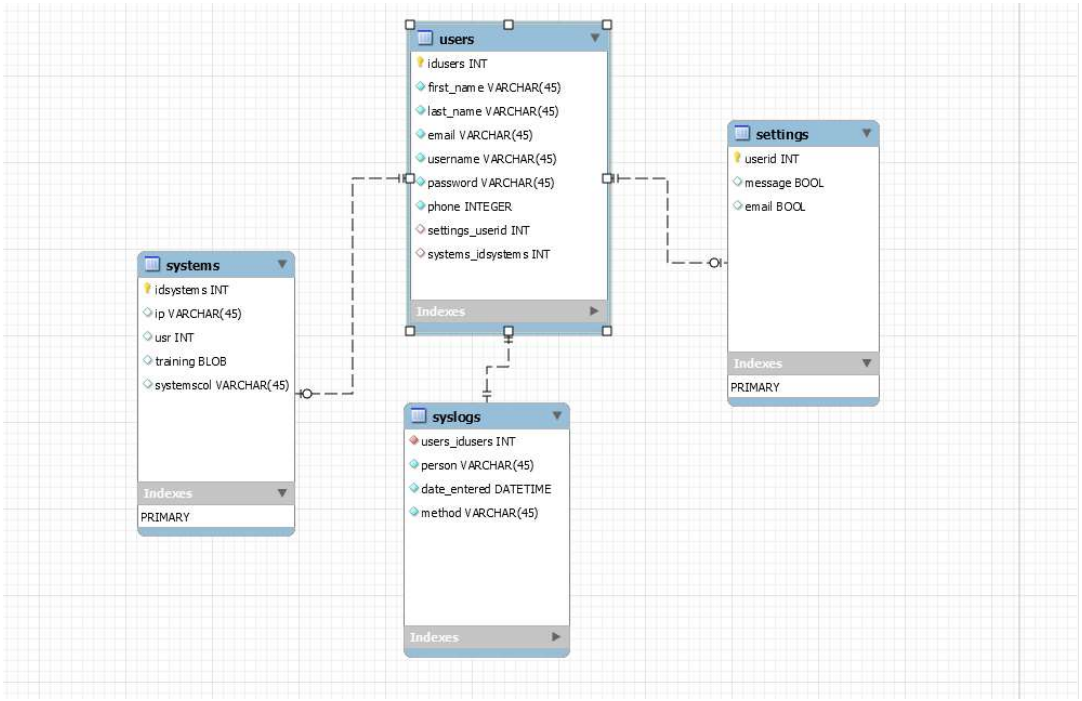
- Generate dynamic page content
- Encrypt data
- Collect form data
- Modify data in database
- Modify files on server
- Send and receive cookies



Back End Server

- Amazon EC2
  - Scalable
  - Secure
  - Easy to network
- Second Raspberry Pi
  - Easy to communicate in same network.
  - Demonstration purposes

Database Schema



Difficulties

- A lot of parts to integrate
- Creating a prototype that is easily portable
  - Buy premade door vs making one out of plywood
- Too much for the Pi to handle
- Time

Member Responsibilities

Member	Power	Locking Mechanism	Entry Sensor	Web application	System programming	Hardware Design
Colleen	+	-	+	-		-
Rick	-	-		+	-	+
Bruno		+	-	-	+	-

Budget

Part	Quanity	Budgeted Price	Unit Price	Total Cost
Door	1	$ 40.00	$ 32.00	$ 32.00
Screws (3 inch)	1	$ 5.00	$ 7.98	$ 7.98
Screws (4 3/4 inch)	1	$ 5.00	$ 3.98	$ 3.98
Hinges	1	$ 10.00	$ 7.98	$ 7.98
Raspberry Pi 2 B+	1	$ 40.00	$ 39.95	$ 39.95
Bluetooth 4.0 USB adapter	1	$ 10.00	$ 8.98	$ 8.98
Logitech C310 Webcam	1	$ 30.00	$ 30.00	$ 30.00
Motion Sensor	1	$ 15.00	$ 5.00	$ 5.00

Budget

Part	Quanity	Budgeted Price	Unit Price	Total Cost
PiTFT 480x320 Touch LCD Screen	1	$ 45.00	$ 44.95	$ 44.95
Pet door screws	1	$ 5.00	$ 1.18	$ 1.18
2x4	3	$ 15.00	$ 2.92	$ 8.76
Electric Strike	1	$ 30.00	$ 29.95	$ 29.95
Black spray paint	2	$ 5.00	$ 3.87	$ 7.74
Electric Imp	1	$ 30.00	$ 25.00	$ 25.00
Electric Imp April Dev Board	1	$ 12.50	$ 12.50	$ 12.50
Wall adapter	1	$ 10.00	$ 7.99	$ 7.99

Budget

Part	Quanity	Budgeted Price	Unit Price	Total Cost
Magnets	1	$ 5.00	$ 5.86	$ 5.86
9V batteries	1	$ 10.00	$ 8.49	$ 8.49
Door handle	1	$ 20.00	$ 14.99	$ 14.99
Light Blue Bean	1	$ 20.00	$ 30.00	$ 30.00
Fingerprint Scanner	1	$ 33.50	$ 31.95	$ 31.95
Male to female cables	1	$ 2.00	$ 2.05	$ 2.05
Proto boards	1	$ 5.00	$ 5.20	$ 5.20
Barrel jack adapter 2.1mm	1	$ 3.49	$ 3.49	$ 3.49

Budget

Part	Quanity	Budgeted Price	Unit Price	Total Cost
Magnetic Contact switch	1	$ -	$ 5.95	$ 5.95
Other PCB components	2	$ 30.00	$ 22.15	$ 44.30
Servo	1	$ 15.00	$ 9.95	$ 9.95
PCB printing	2	$ 50.00	$ 44.50	$ 89.00
Pet Door	1	$ 10.00	$ 21.98	$ 21.98
	Total:	$ 511.49	Total:	$ 547.15

Financing

- Financed by Boeing for $334.53
- The group has split the $212.00 over this amount between the members

QUESTIONS?