A1 Security System

Smart Integrated Home Security Solution

Meet The Team

Group 4

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- Brandon James, CpE
- Jonathan Chew, EE

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University of Central Florida
Dr. Lei Wei

Project Motivation

- 2.5 million property intrusions reported annually (US Department of Justice)
- 75% of all burglaries occur on residential property
  - In addition to that figure, 30% of these burglaries happen when the household leaves the front door unlocked/unattended
- Humans also tend to forget items (ex. keys, wallets, phones)
- Smart IoT devices are becoming more attractive to consumers
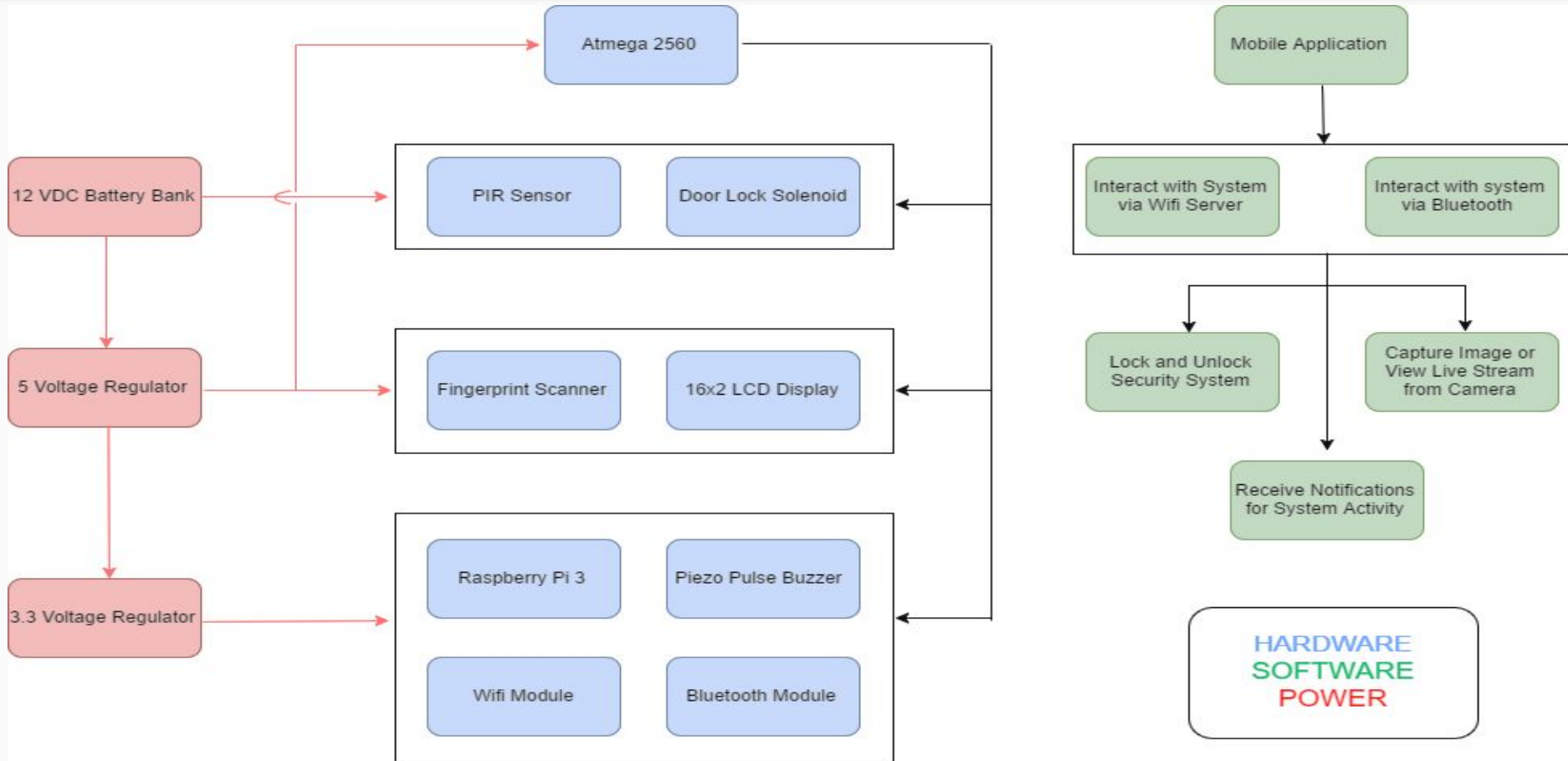- Gain additional hands-on experience with integrated technology and team dynamics

Goals & Objectives

- To create an all-in-one home security locking system that is more secure through other means other than the traditional physical key
- Affordable for the general population
- Easy installation procedure
- Interact with A1 Security System seamlessly through mobile application
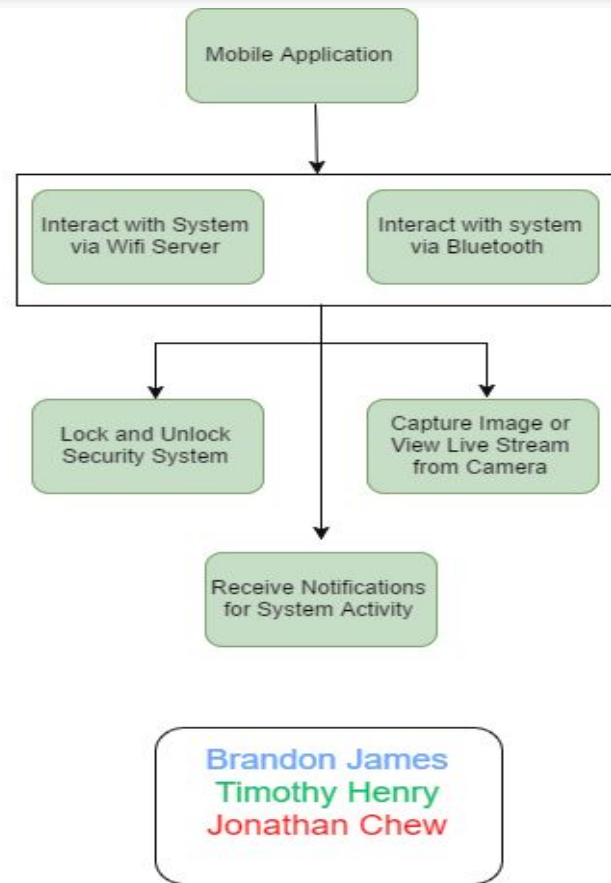- Mobile application to be effective and user-friendly
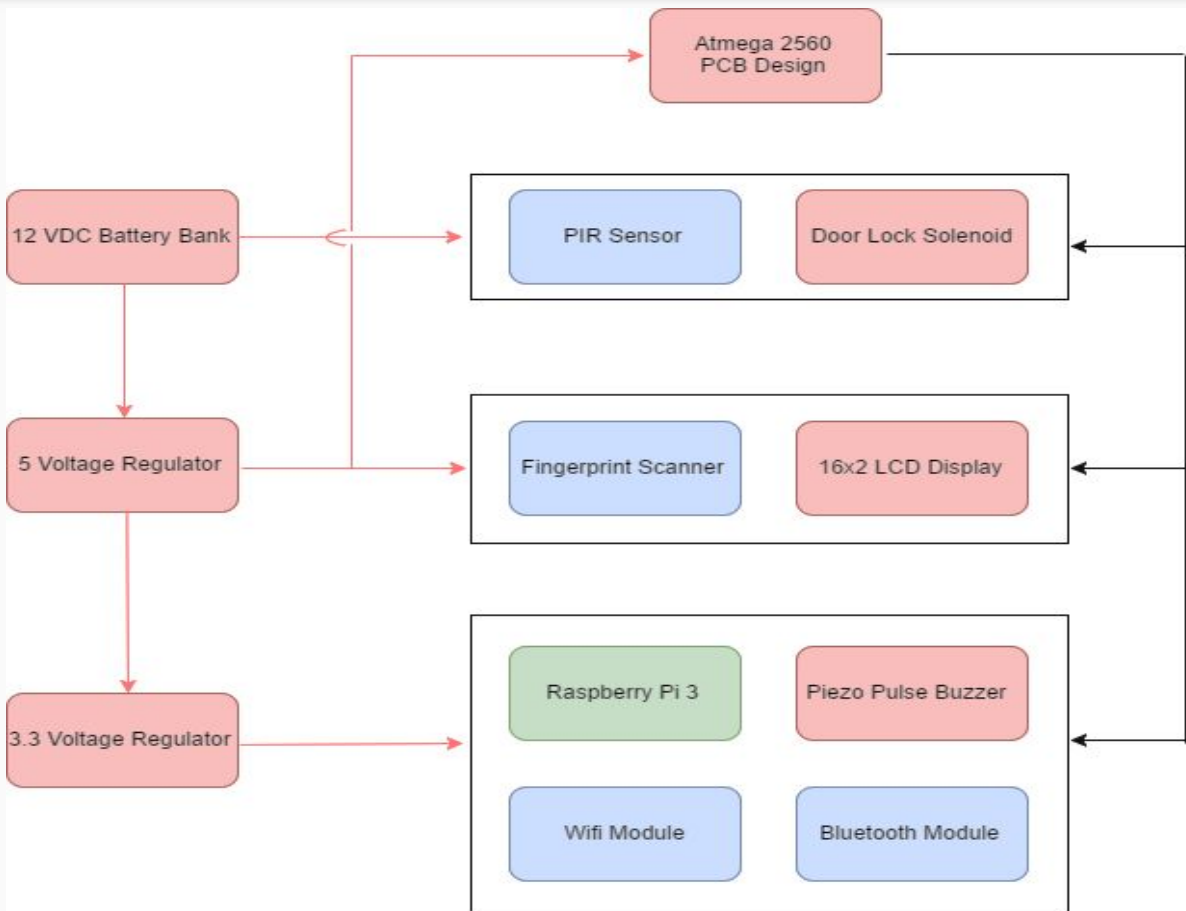- Low power system

Specifications & Requirements

- Main controller shall control all peripherals autonomously after proper system installation.
- All components will be assembled and attached onto door.
- Designed to have installation times under 20 minutes.
- LCD to show battery health and update the user with door lock status.
- Motion sensor to detect movement from at least 10 feet away.
- Efficient bluetooth communication at 15 feet of distance from system.
- Interface for mobile application shall be user friendly and give access to security system features.
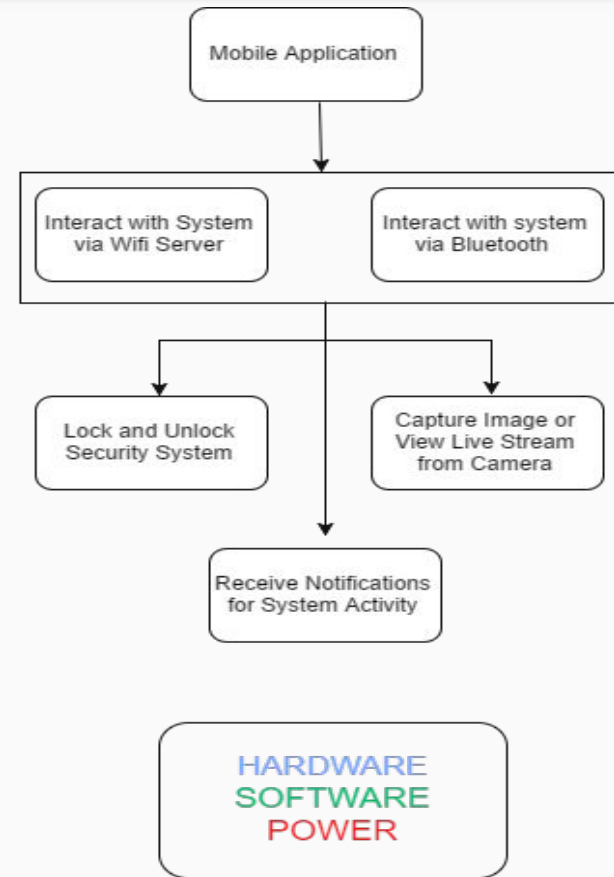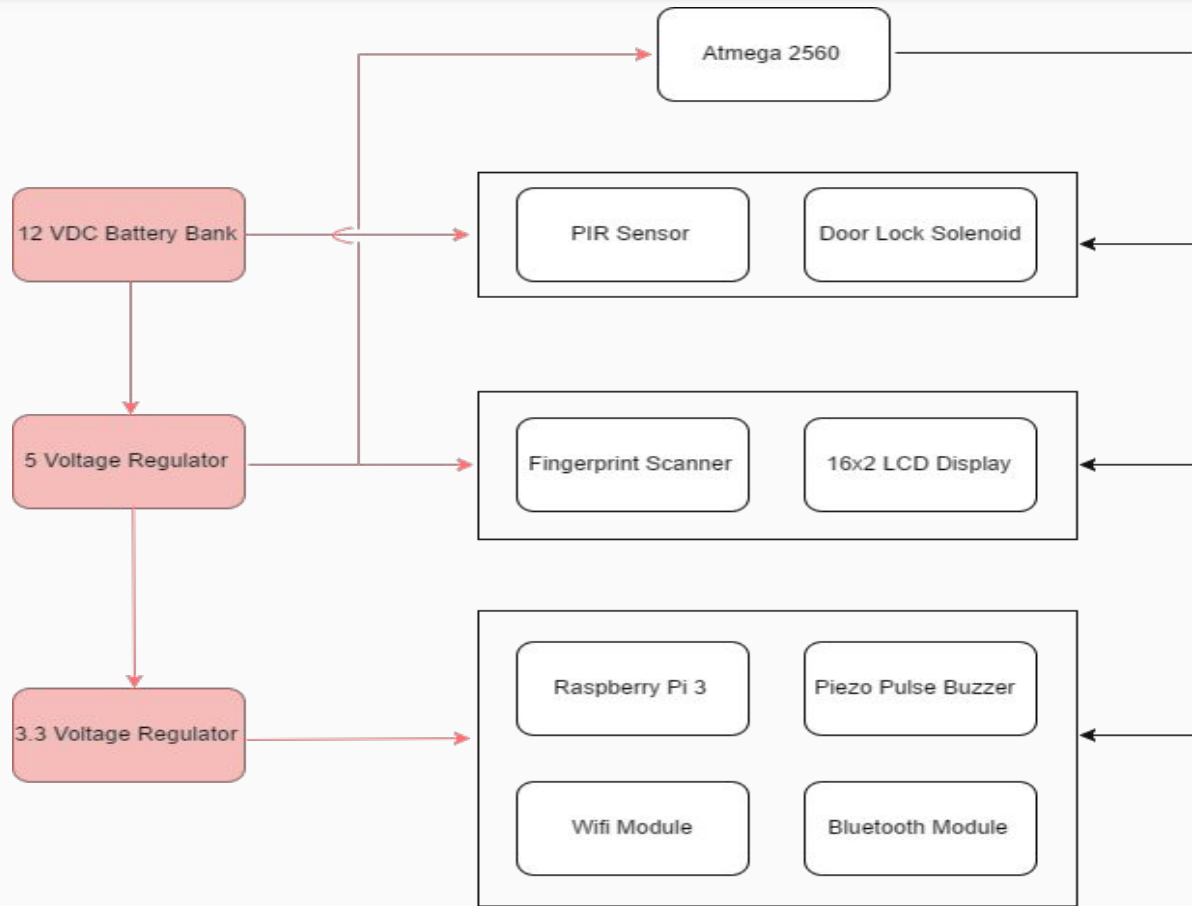
Overall Block Diagram

Responsibilities

Atmega 2560
PCB Design

12 VDC Battery Bank

5 Voltage Regulator

3.3 Voltage Regulator

PIR Sensor

Door Lock Solenoid

Fingerprint Scanner

16x2 LCD Display

Raspberry Pi 3

Piezo Pulse Buzzer

Wifi Module

Bluetooth Module

Mobile Application

Interact with System via Wifi Server

Interact with system via Bluetooth

Lock and Unlock Security System

Capture Image or View Live Stream from Camera

Receive Notifications for System Activity

Brandon James
Timothy Henry
Jonathan Chew

Power Management

Power Supply

- **LEDMO's LED Power Supply**

- **100-240 VAC to 12VDC Adapter**

- **Capable of supplying up to 5A**

- **Power input through DC barrel jack.**

- **Advantages: Image Processing Capabilities and High Output**

Backup Battery Supply

	SMAKN 8PCS AA Battery 12V Clip Holder Box Case Black	TalentCell Li-Ion 12 VDC Rechargeable Battery Bank
Voltage Output	12 VDC	12 VDC
mAH	Varies	6000
Price	$5.66 + 8 AA batteries	$29.99
Dimensions	7.7 x 6.1 x 1.7 inches	4 x 8.8 x 1.5 inches

DC 5.5X2.1mm 1 Female to 2 Male Power Splitter Cable

12.6V/1A Charger

Power Management

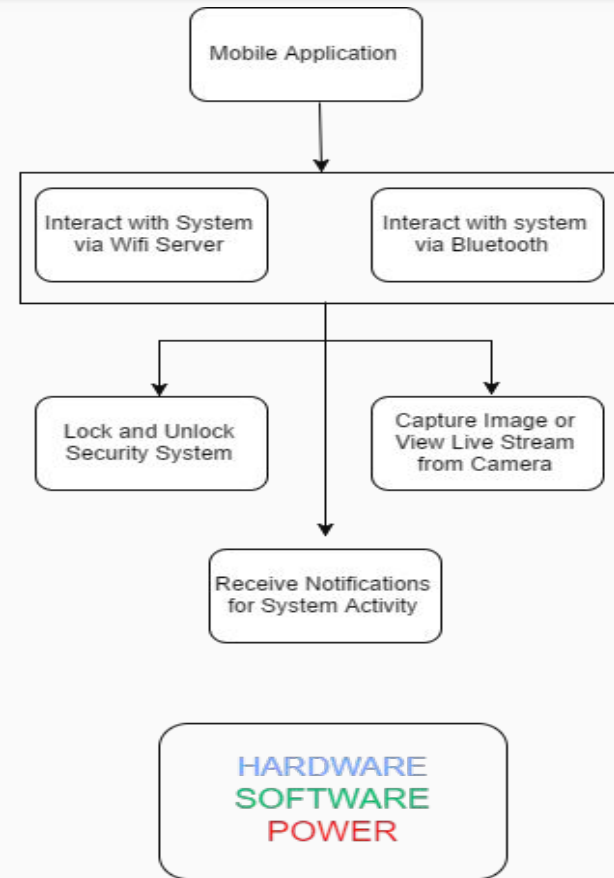|	LM1085it-5	LM2678
Manufacturer	Texas Instruments	Texas Instruments
Output Voltage	Fixed 5V	Adjustable
Output Current	3A	5A
Max Input	18V	45V
Price	$1.96	$5.59
Topology	Linear	Step-down (Buck)
Package	TO-220	TO-220(7)

LM1085it-5.0

LM2678

Hardware Peripherals
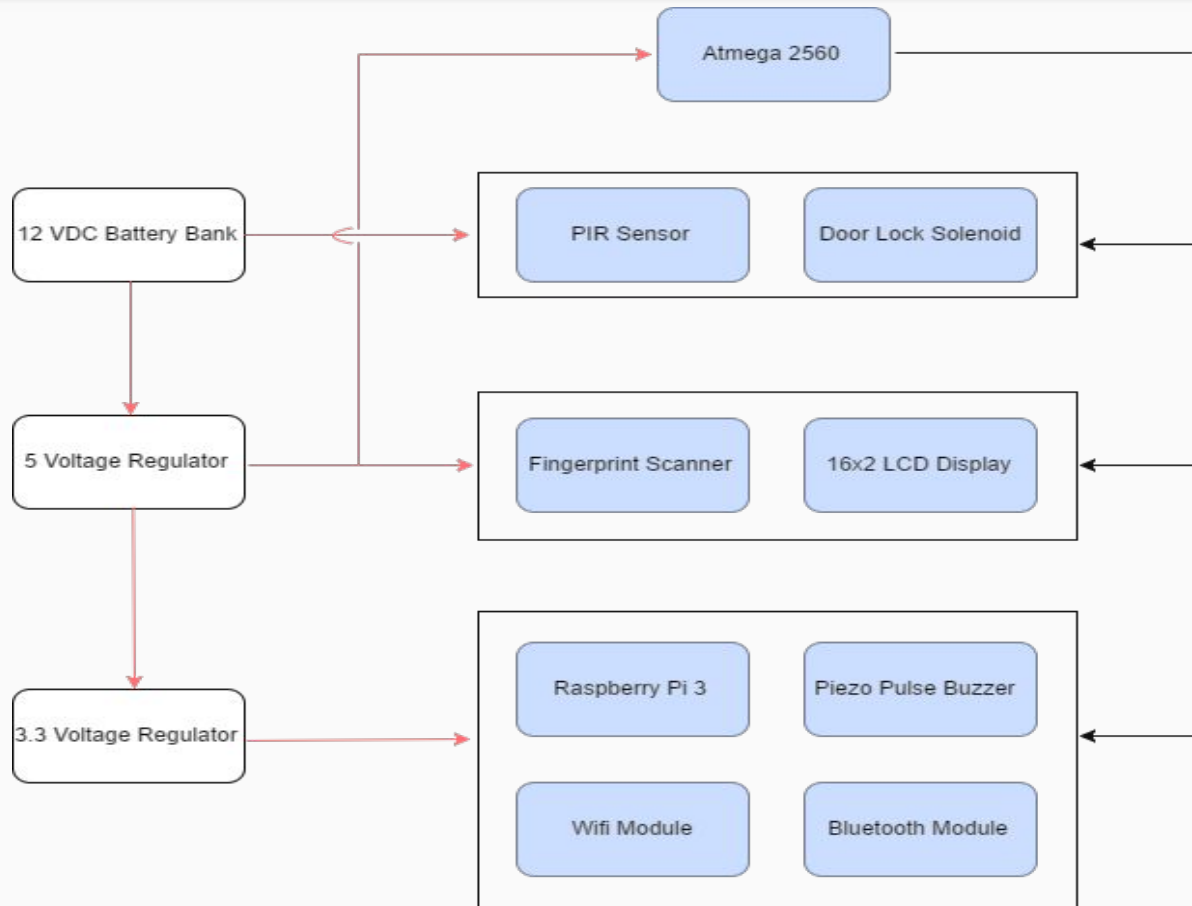
Microcontroller
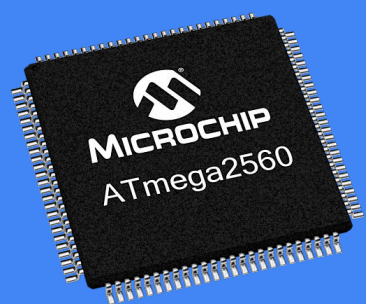
Atmega2560

ESP32

Categories	Atmega2560	ESP32
CPU Speed	16 MHz	160 MHz
Memory	256 KB	520 KB
Ideal Operating Voltage	5 Volts	3.3 Volts
Communication Peripherals	4xUART, 5xSPI, 1xI²C	3xUART, 4xSPI, 2xI²C
Wireless Connectivity	--	WiFi 802.11 Bluetooth 4.2/BLE
Size	14 x 14 mm	6 x 6 mm
Price	$18	$3-6
Manufacturer	Microchip Technology/Atmel	Espressif

Electronic Door Lock
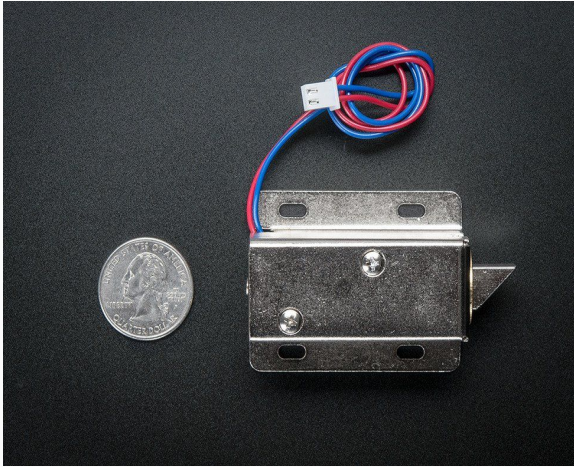
Name	FCBB Electromagnetic Door Lock Solenoid	Uxcell Open Frame Type Solenoid
Voltage	12 VDC	12 VDC
Current Drawn	0.75 A	1.30 A
Price	$8.20	$19.99
Dimensions (L x W x H)	2.6" x 1.6" x 1"	2.6" x 1.7" x 1.2"
Weight	150 g	205 g

LCD Display

- Standard 16x2 LCD display using I2C communication
- Responsible for displaying battery percentage and door lock status.
- The LCD backlight brightness adjustable using 10k potentiometer
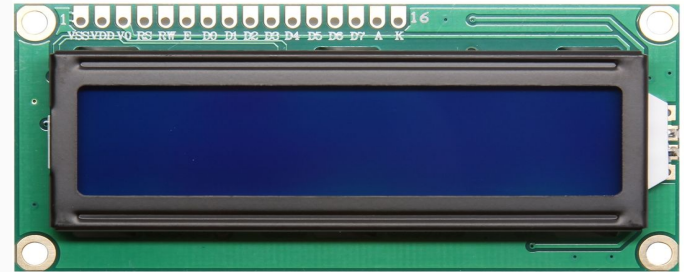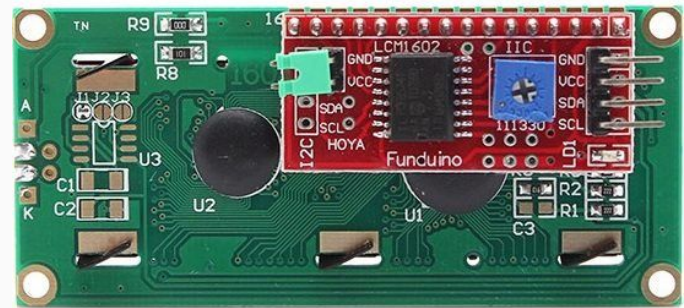
Battery Monitoring

- Microcontroller will check if the backup battery supply is being used at startup.

- Microcontroller will switch power off to Raspberry Pi once ADC value drops below 655 to conserve battery life.

- AA Lithium Ion batteries are recommended for the backup supply. Capable of 3000 mAH ratings.

- Backup supply can last up to 3 days after calculation, averaging 3 person household

Battery Voltage	Divided Voltage	Battery Health Percentage	ADC Value
12.60 V	3.200	100%	~655
12.47 V	3.167	90%	~648
12.34 V	3.134	80%	~641
12.21 V	3.100	70%	~634
12.08 V	3.068	60%	~627
11.95 V	3.035	50%	~621
11.82 V	3.002	40%	~613
11.69 V	2.969	30%	~606
11.56 V	2.936	20%	~599
11.43 V	2.903	10%	~592
11.30 V	2.870	0%	~585

Fingerprint Scanner

GT511C1R

KOOKYE Fingerprint Module

Categories	GT511C1R	KOOKYE Fingerprint Module
Memory	20 Fingerprints	162 Fingerprints
Ideal Operating Voltage	3.3 - 6 Volts	3.8 - 7 Volts
Communication	UART	UART
Window Area	18 x 21 mm	14.5 x 19.4 mm
Dimensions	37 x 17 x 9.5 mm	122 x 81 x 20 mm
Price	$34.95	$32.99
360º Recognition	Yes	No

Motion Sensor
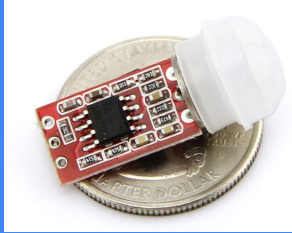
Mini PIR Motion Sensor

PIR Motion Sensor

| Categories	PIR Motion Sensor	Mini PIR Motion Sensor
Ideal Operating Voltage	5 - 12 Volts	5 - 9 Volts
Communication	Digital	Digital
Detection Angle	110º	<100º
Detection Distance	23 Ft	23 Ft
Dimensions	80 x 50 x 27 mm	28 x 13 x 13 mm
Price	$3.20	$5.90

Magnetic Switch Reed

- Purpose is to sense when the door is closed/unclosed
- Digital I/O pin shall read the connection for the switch
- When door is closed the MCU will read a voltage HIGH, and LOW when switch is opened
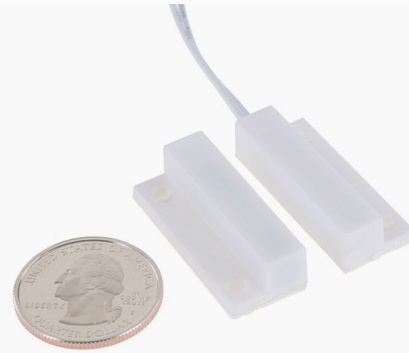
Wi-Fi Module
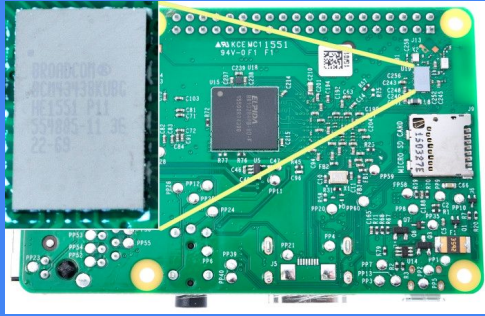
BCM43143
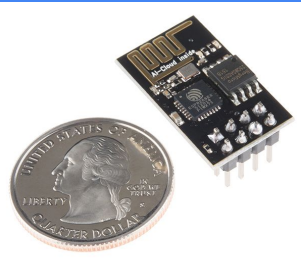
ESP8266

Categories	ESP8266	BCM43143 (Raspberry Pi 3)
Protocol	802.11b/g/n	802.11b/g/n
Ideal Operating Voltage	3.3 Volts	1.2 - 3.6 Volts
Frequency	2.4 GHz	2.4 GHz
Communication	UART, SPI, I²C	UART, SPI
Dimensions	18 x 20 mm	7 x 7 mm
Price	$6.95	Preassembled

Bluetooth Module

Categories	HC-05	RN4020
Operating Voltage	3 - 6 Volts	1.8 - 3.6 Volts
Active Current	25 mA	16 mA
Idle Current	< .1 mA	< 5.0 uA
Bluetooth Range	30 Ft	328 Ft
Communication	UART	UART
Price	$5.86	$10.60
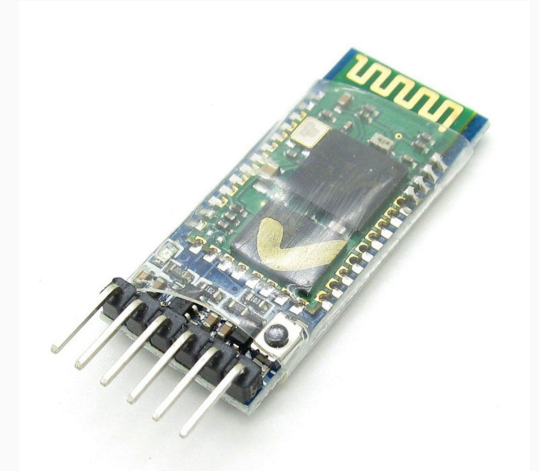
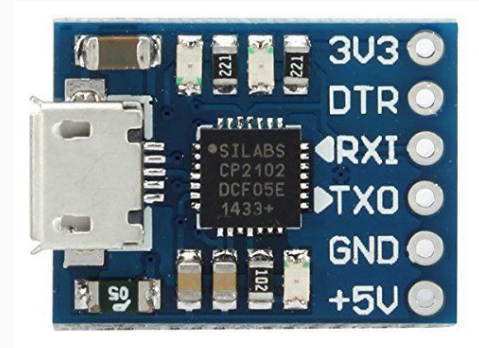
HC-05

Exit Door Switch

- Implemented for easy exiting
- Physical alternative to unlocking system
- Closes a switch to drive door lock solenoid
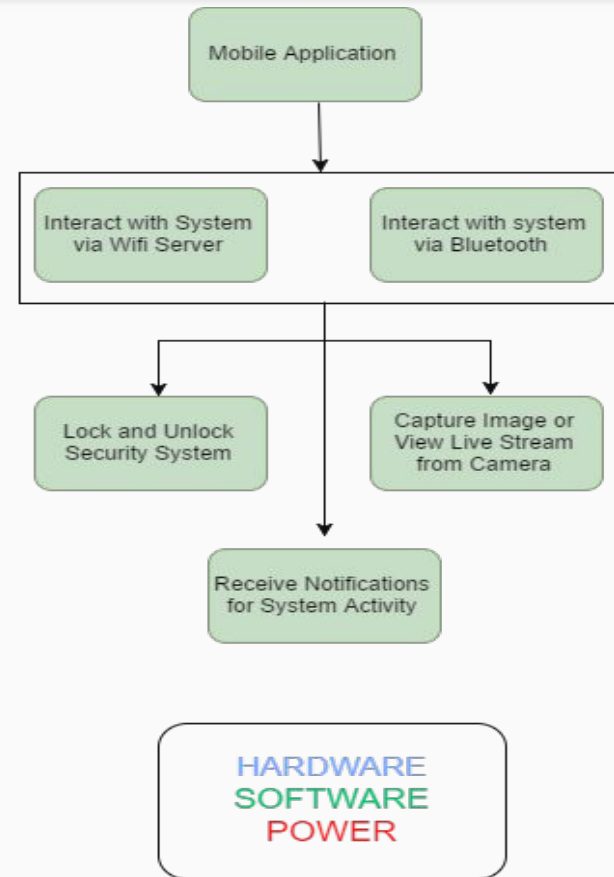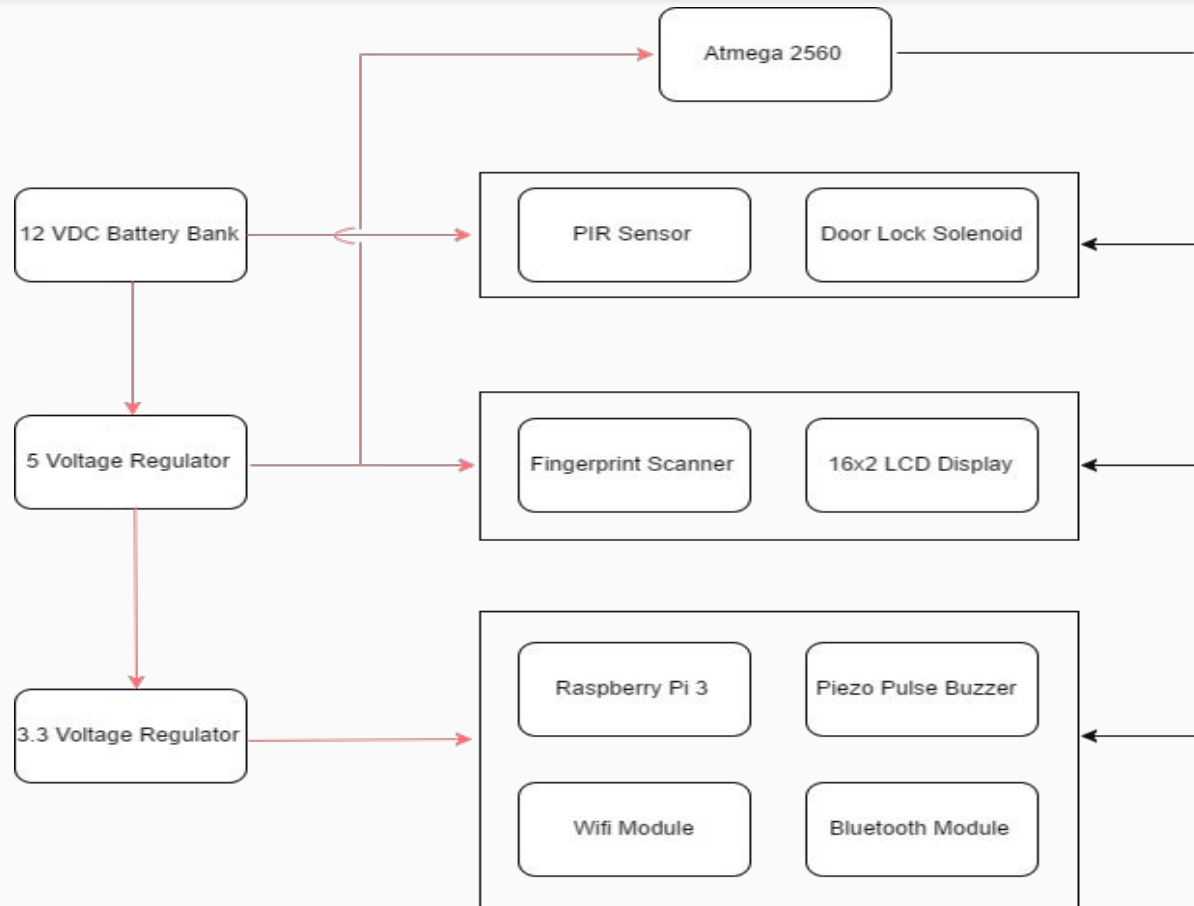

Exit Switch
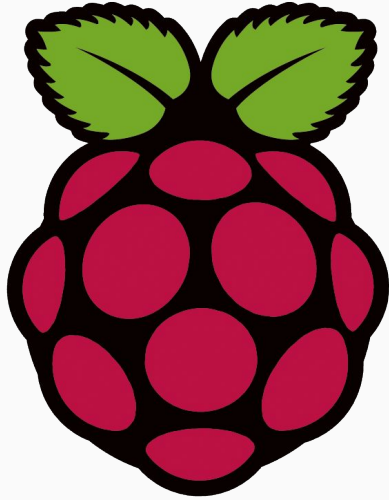
MicroUSB to Serial Adapter

- Contains voltage regulator and level shifter
- Will be used to communicate with Raspberry pi 3
- Will be used to program microcontroller through serial connection

WINGONEER CP2102 Micro USB To TTL/Serial Module UART 6 Pin Serial Converter

Software Architecture

Atmega 2560	
12 VDC Battery Bank	
5 Voltage Regulator	
3.3 Voltage Regulator	
PIR Sensor	Door Lock Solenoid
Fingerprint Scanner	16x2 LCD Display
Raspberry Pi 3	Piezo Pulse Buzzer
Wifi Module	Bluetooth Module

Mobile Application

Interact with System via Wifi Server

Interact with system via Bluetooth

Lock and Unlock Security System

Capture Image or View Live Stream from Camera

Receive Notifications for System Activity

HARDWARE
SOFTWARE
POWER

Raspberry Pi 3 Primary Purpose

- Primarily responsible for handling photos and videos
- NoIR Camera V2
- Raspbian

- Python used as main language
- Pyrebase Library(Firebase)
- Raspicam Library
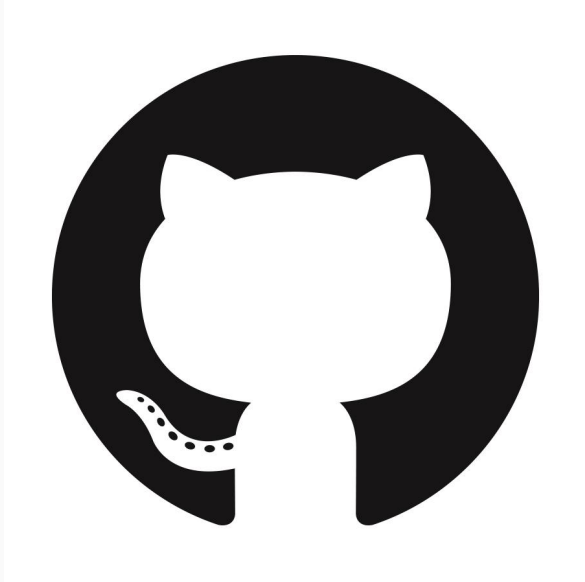- Serial
- Google Cloud Storage

Mobile Application

Main Purpose:

- Primary Bridge between user and system

Why Android?

- Java Familiarity
- Android'sOpeness
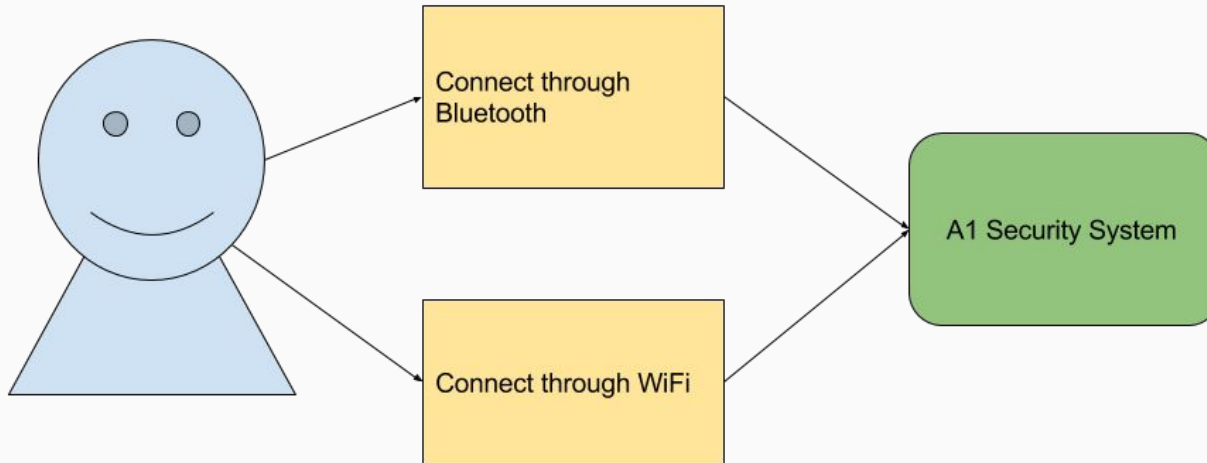- Broad Reach(82% of sales in Q4 2016)
- Third Party Library Support

Mobile Application Tools

- Using Android Studio
- Minimum API: 19(4.4 KitKat)
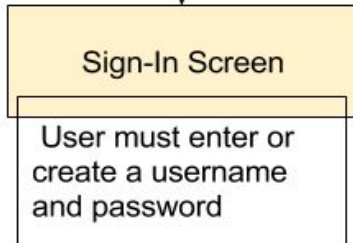- GitHub
- Firebase Android Library

Communication with the Mobile Application

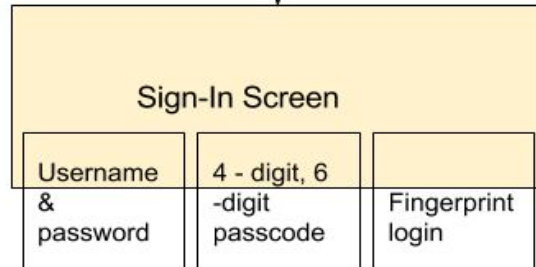- WiFi or Bluetooth(Bluetooth Quick Unlock)
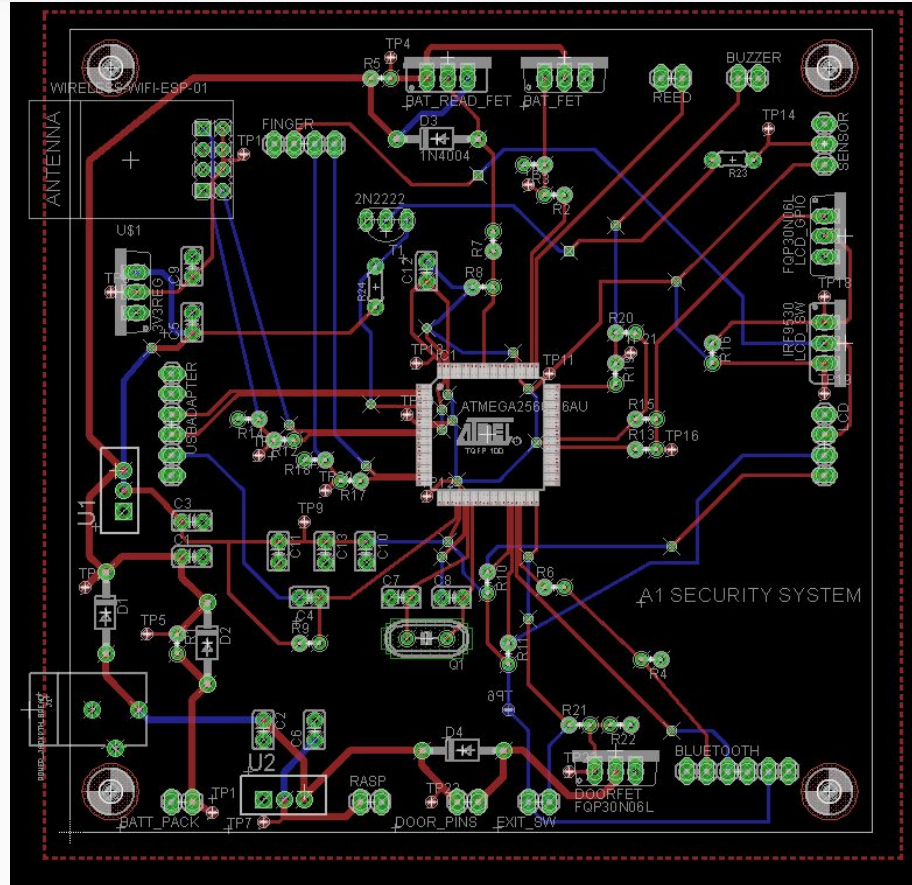
Security In the Application

- Fingerprint
- Pin
- Username & password

Controlling the A1 Security System

- Activate/Deactivate Security System
- View gif of visitor
- View history of events with details

Overall Schematic
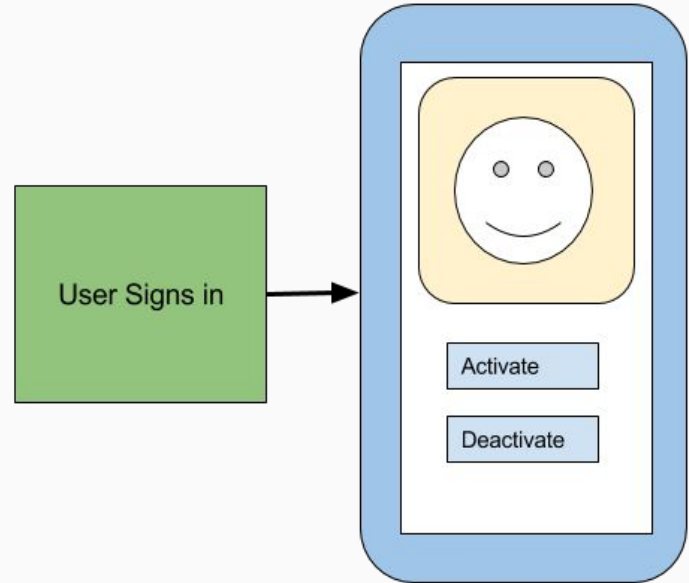
Budget and Financing

Item	Quantity	Cost per Unit	Total Cost
Magnetic Switch	1	$2.95	$2.95
Piezo Buzzer	1	$7.00	$7.00
Battery Power Supply	1	$30.00	$30.00
USB-Serial Adapter	1	$7.00	$7.00
Lock Solenoid	1	$12.99	$12.99
Motion Sensor	1	$5.79	$5.79
Breadboards	1	$7.99	$7.99
Jumper Wires	1	$6.99	$6.99
ESP8266	1	$5.99	$5.99
Fingerprint Scanner	1	$33.00	$33.00

Item	Quantity	Cost per Unit	Total Cost
N-Channel MOSFET	4	$0.95	$3.80
P-Channel MOSFET	2	$0.95	$1.90
Camera NoIR	1	$8.29	$8.29
LM7805 (voltage regulator) x 4	1	$2.48	$2.48
LM1117DT-3.3 (voltage regulator) x 2	1	$12.99	$12.99
Crystal 16MHz	1	$5.00	$5.00
Solder Rosen Core	1	$8.00	$8.00
Exit Switch	1	$2.77	$2.77
1st PCBs	1	$72	$72

Item	Quantity	Cost per Unit	Total Cost
8 Battery Holder	1	$5.66	$5.66
Atmega2560	1	$18.00	$18.00
Power Supply 120VAC/12VDC	1	$9.38	$9.38
Heat Shrink	1	$5.88	$5.88
2nd PCBs	1	$58.00	$58.00
New Diodes/Regulator	1	$9.83	$9.83
Plain PCBs 10pcs	1	$6.50	$6.50
LM1085IS-3.3/NOPB	2	$5.02	$10.04
NoIR Extension	1	$8.29	$8.29

Item	Quantity	Cost per Unit	Total Cost
Raspberry Pi 3	1	$35.70	$35.70
16x2 LCD Display	1	$6	$6

Total Amount	410.21

Questions?