

Smart Dumpster

Group 24

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Introduction

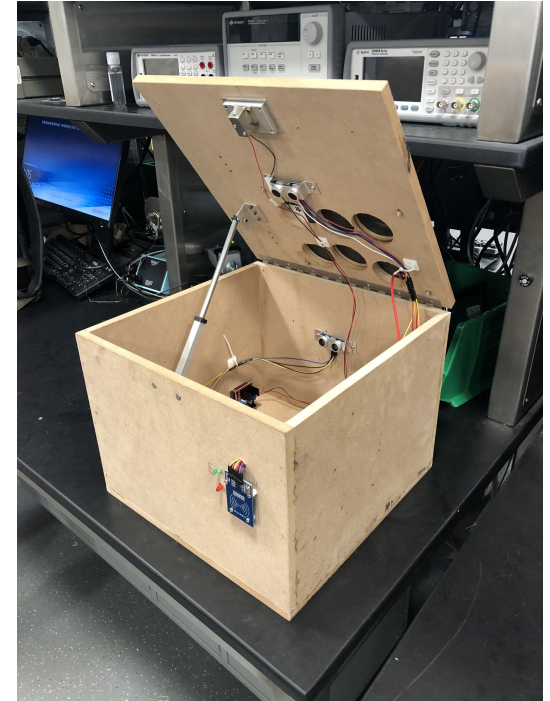
Challenges in Regular Dumpsters

- **Usage of Dumpsters by Non-Residents**
- **Garbage Overflow from the Dumpsters**
 - Often makes it dirtier than it should be
- **Heavy Plastic Lid**
 - Anywhere from 5 - 15 lb Lid



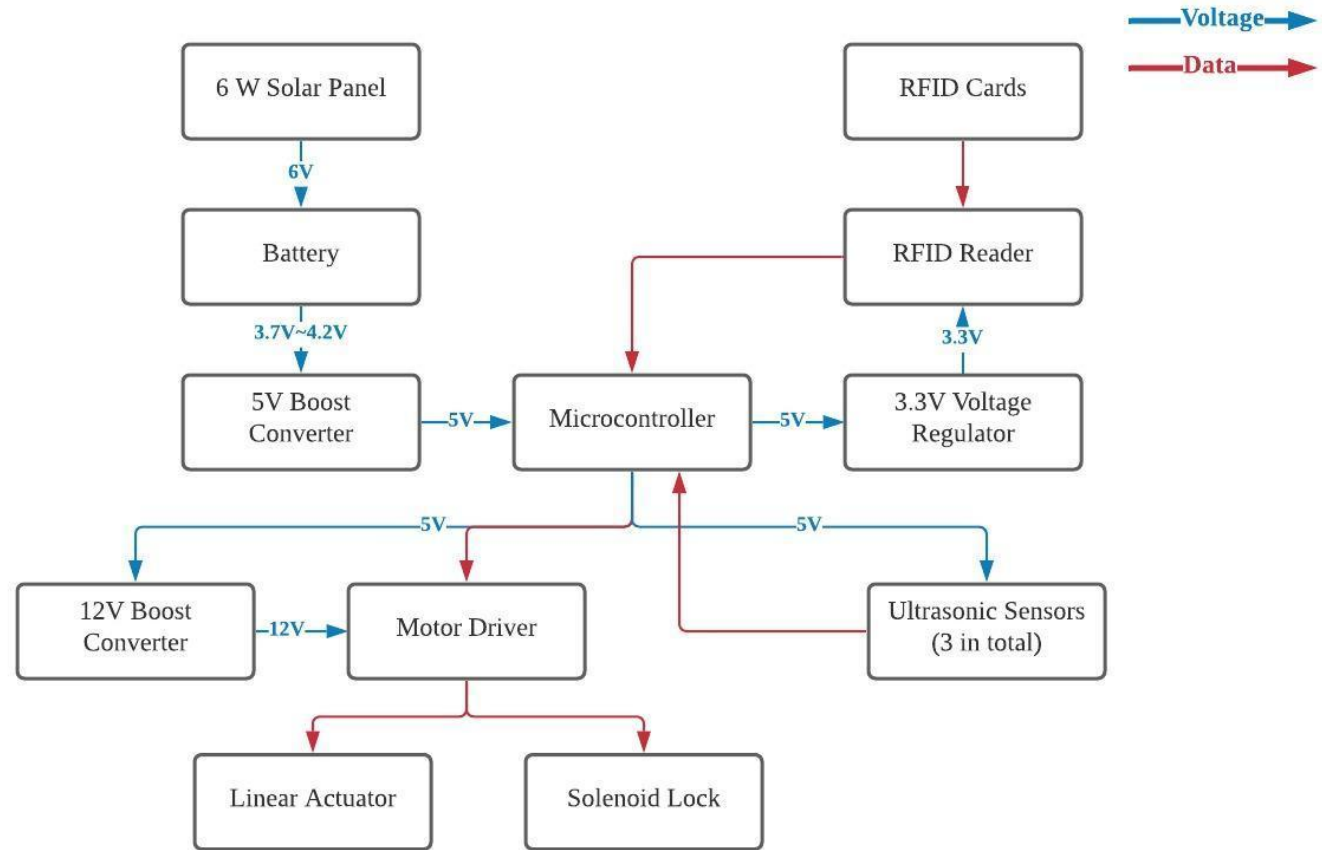
Features

- **Automatic Locking System**
- **Automatic Lid Opening System**
- **Fullness Detection**
- **Solar-Powered Battery**

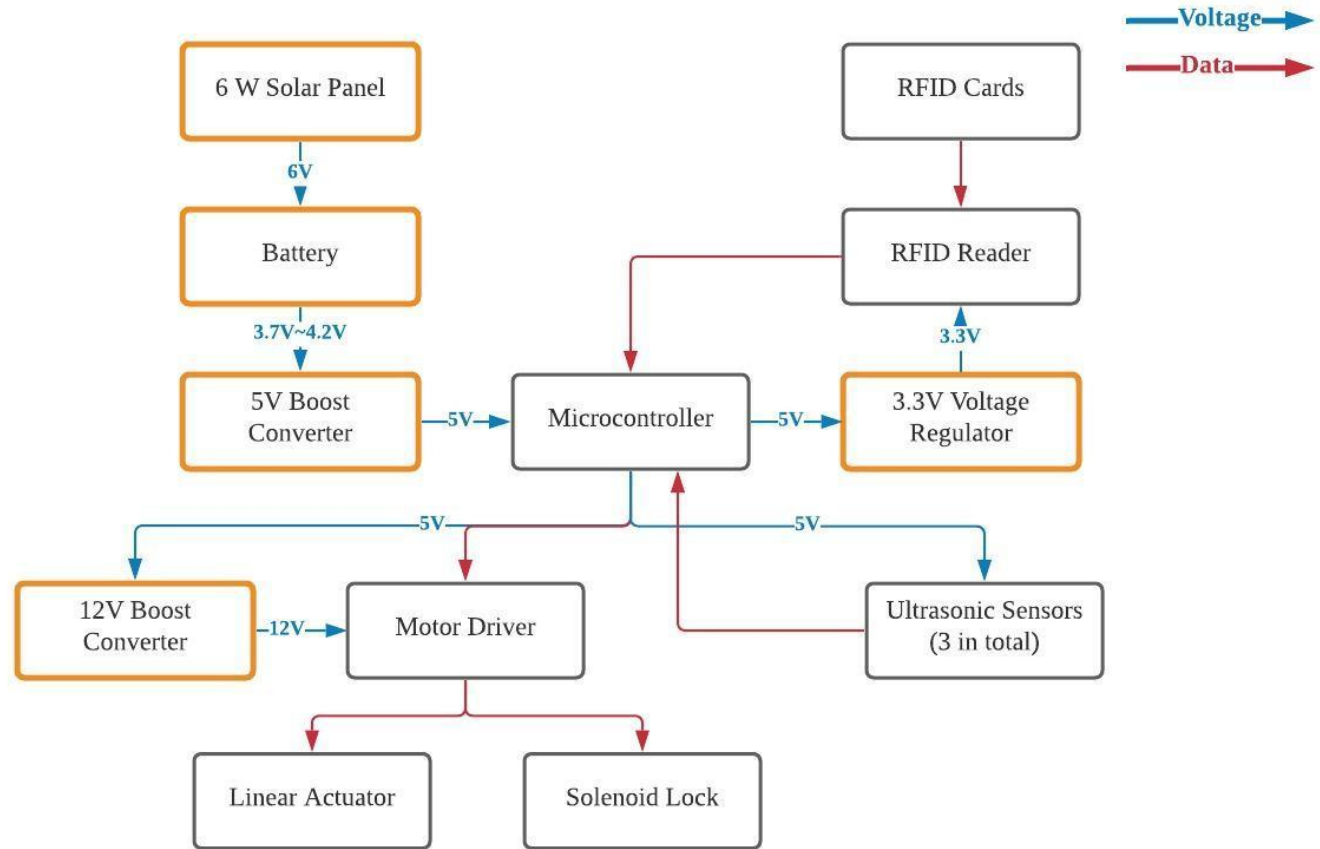


System Overview

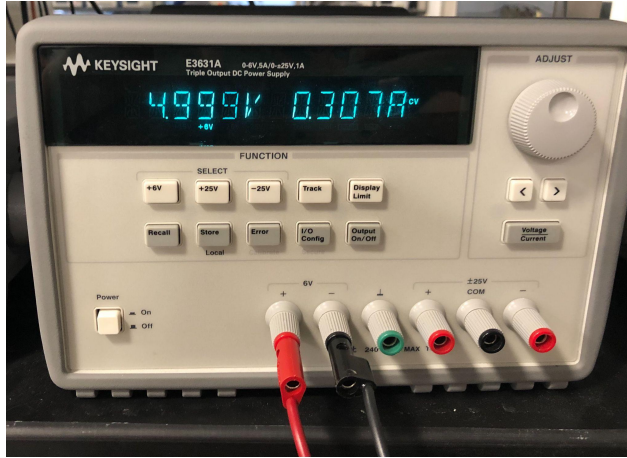
Block Diagram



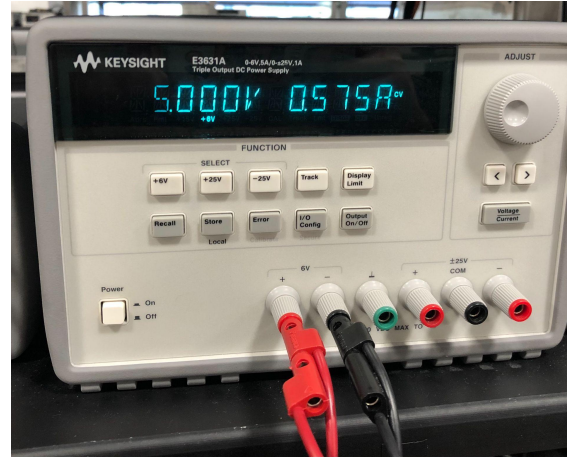
Power Group



Power Group



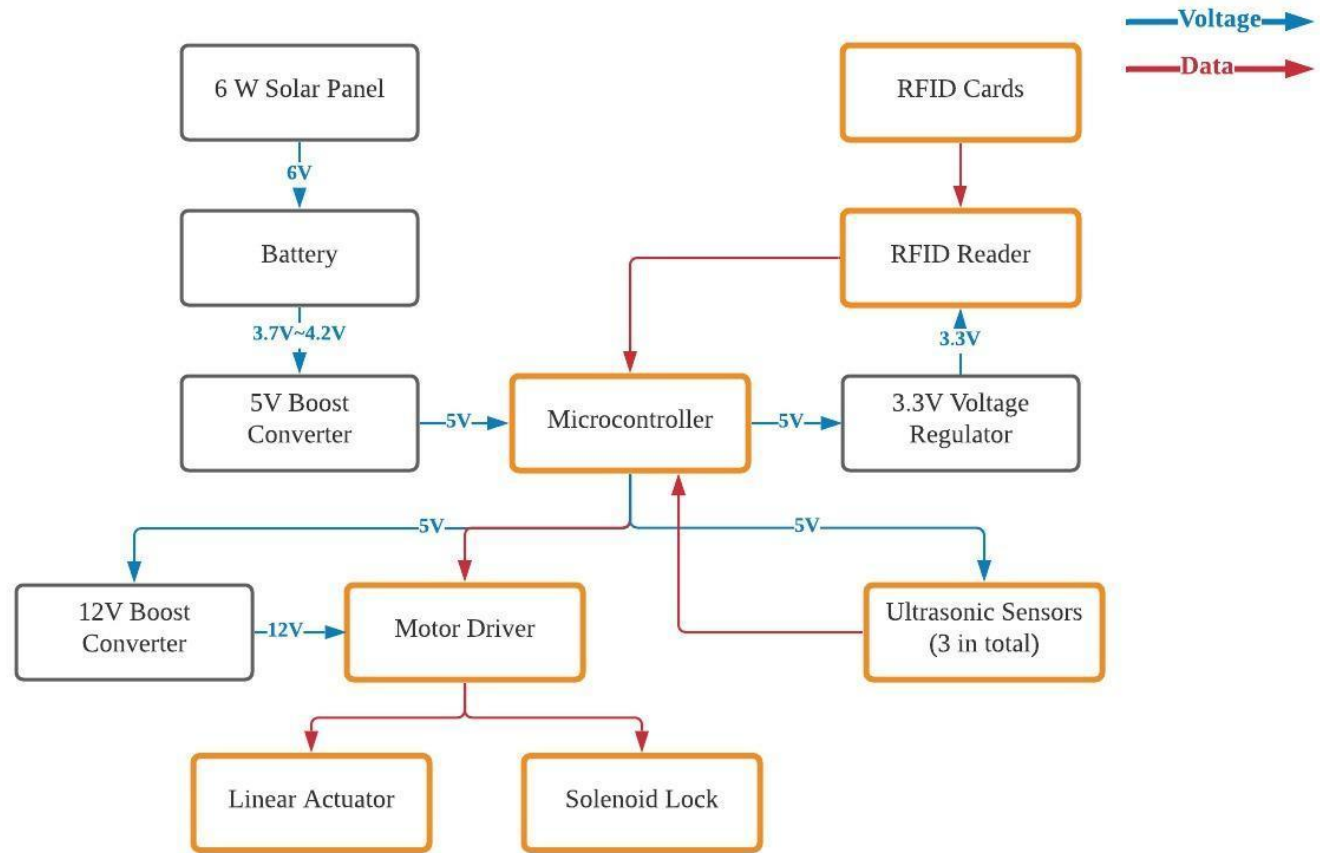
Idle



Active



Control Group



RFID Card/Reader

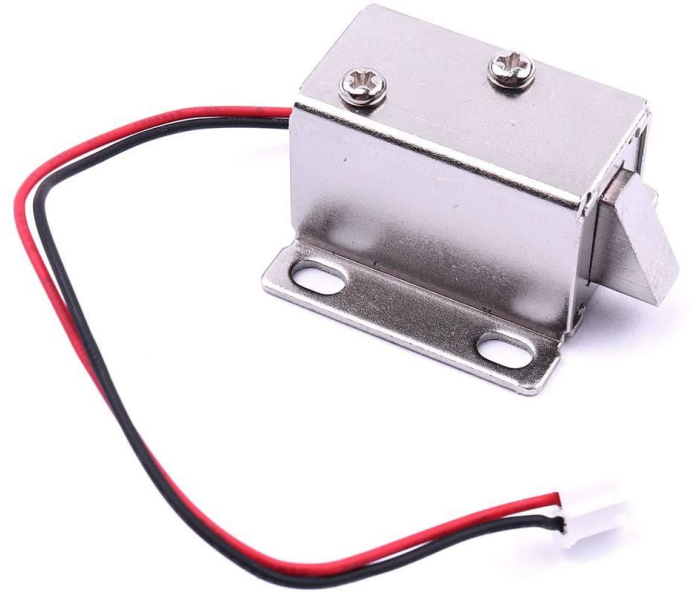


Picture of Serial Monitor

```
Start Your Scan
UID Number :36dabbf8
1
UID Number :36dabbf8
2
UID Number :36dabbf8
3
UID Number :36dabbf8
4
UID Number :36dabbf8
5
```

Solenoid Lock

- Input Voltage of 12V
- Default locked; Unlocked when provided with voltage
- Iron material strong enough to not break with human force



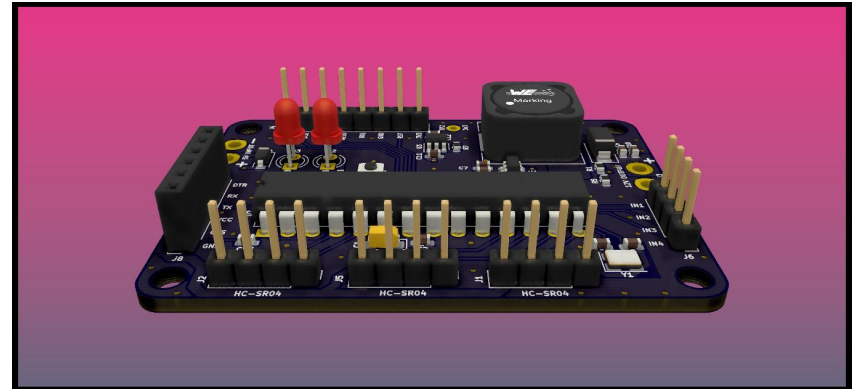
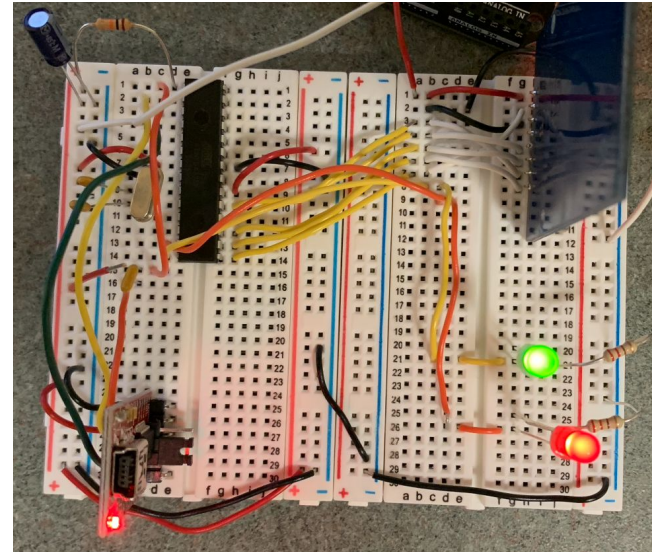
Linear Actuator

- 6 inch extension possible
 - Retracted Length of 10.4 inch
 - Extended Length of 15.9 inch
-
- Positive 12V to extend
 - Negative 12V to retract



Processing Unit

- Microcontroller (ATMega328 Chip)
- Reprogrammable FTDI Chip (FT232RL)
- Inputs: RFID Sensor, Ultrasonic Sensors
- Outputs: Linear Actuator, Solenoid Lock, LEDs



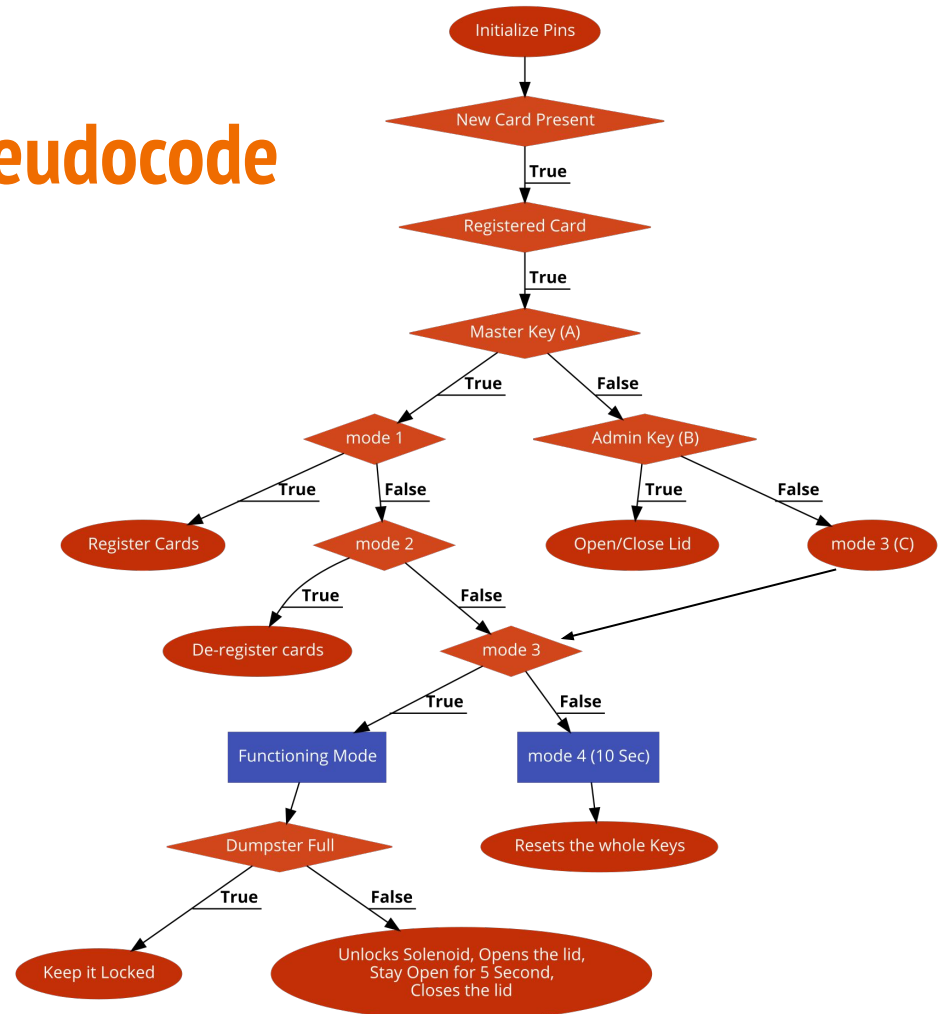
Software

- SPI Library
 - Library to communicate with a peripheral devices quickly
 - In this case it would be RFID Reader
- MFRC522 Library
 - Library that helps read/write of RFID card/tag
- Pre-registered Cards
 - Master card
 - Admin card

```
String director_card = "36dabbf8";  
String admin_card = "477868b3";|
```

High Level Overview / Pseudocode

- 4 Master State
 - Register Cards
 - Deregister Cards
 - Functioning State
 - Reset
- 3 Key States
 - Master Key
 - Admin Key
 - User Key

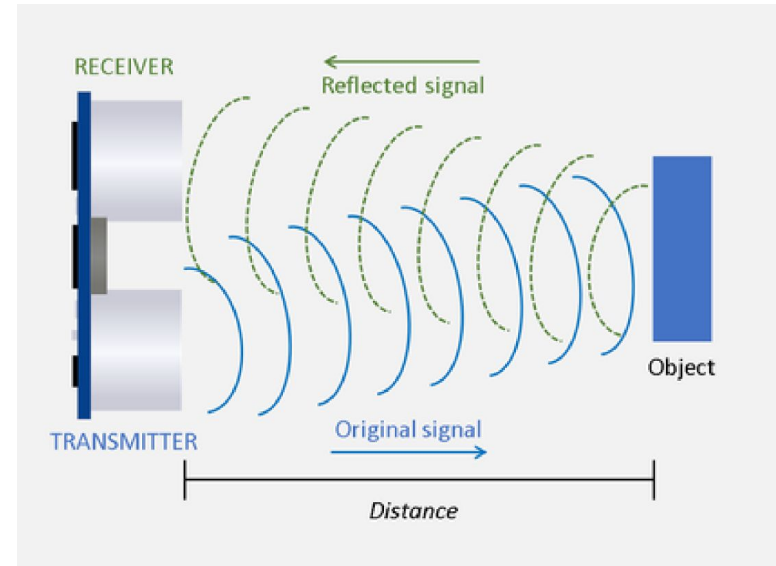


Purposes of Each Card

- Master Card
 - Aimed for the owner of the Apartments
 - Registers, De-registers, or Resets the whole system
- Administrator Card
 - Aimed for the Maintenance people who cleans the dumpster
 - Open and Close regardless of the fullness
- User Key
 - Aimed for the residents
 - Only open when the dumpster isn't full

Overflow Protection

- Three sensors to detect length, height, and depth of the garbage in the box
- Sends 40000 HZ sonic burst from Trig and receives on Echo pin
- Detection Distance from 2cm to 500cm



Overflow Protection

- Input: 8 cycle sonic burst (Trig Pin)
- Output: Time in microseconds the sound wave traveled (Echo Pin)
 - Divide by 2 as it travels forward and bounce backward
- Calculation
 - Velocity of sound = 340 m/s = .034 cm/ μ s
 - Time = Distance / Speed => Distance = Speed * Time
 - $D = .034 \text{ cm}/\mu * t / 2$

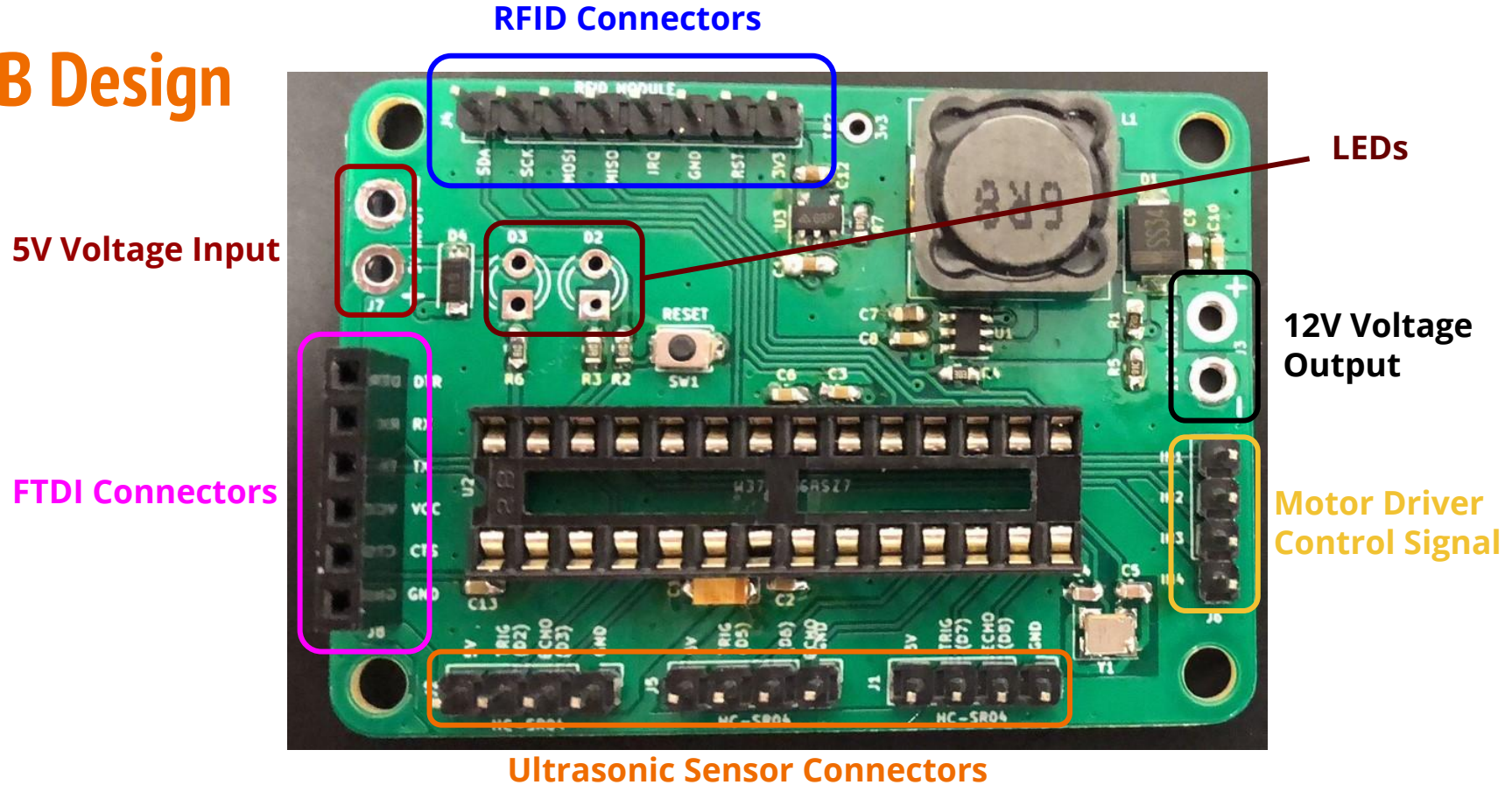
Overfill Protection

- Serial Monitor outputs distance measured by three ultrasonic sensors
- Check whether the actual dumpster closes when it's full
 - Green LED flashes but doesn't open the dumpster

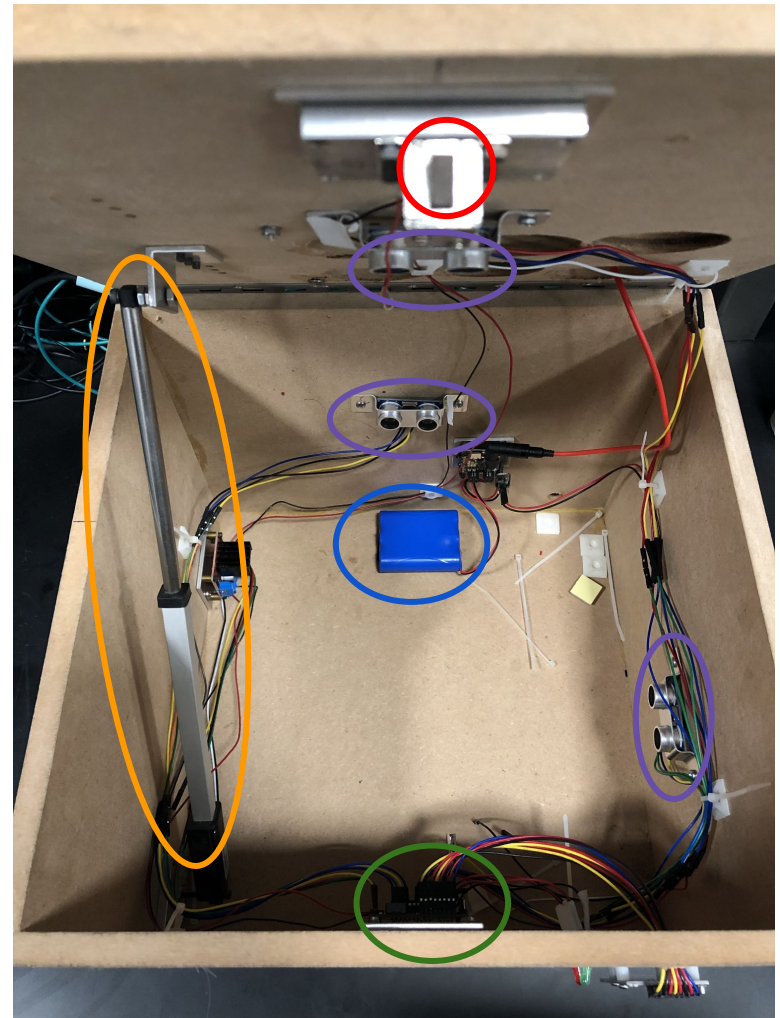
```
Distance = 29.70 cm
Distance = 30.27 cm
Distance = 30.13 cm
Distance = 29.70 cm
Distance = 29.70 cm
Distance = 29.76 cm
Distance = 30.27 cm
```

Picture of Serial Monitor

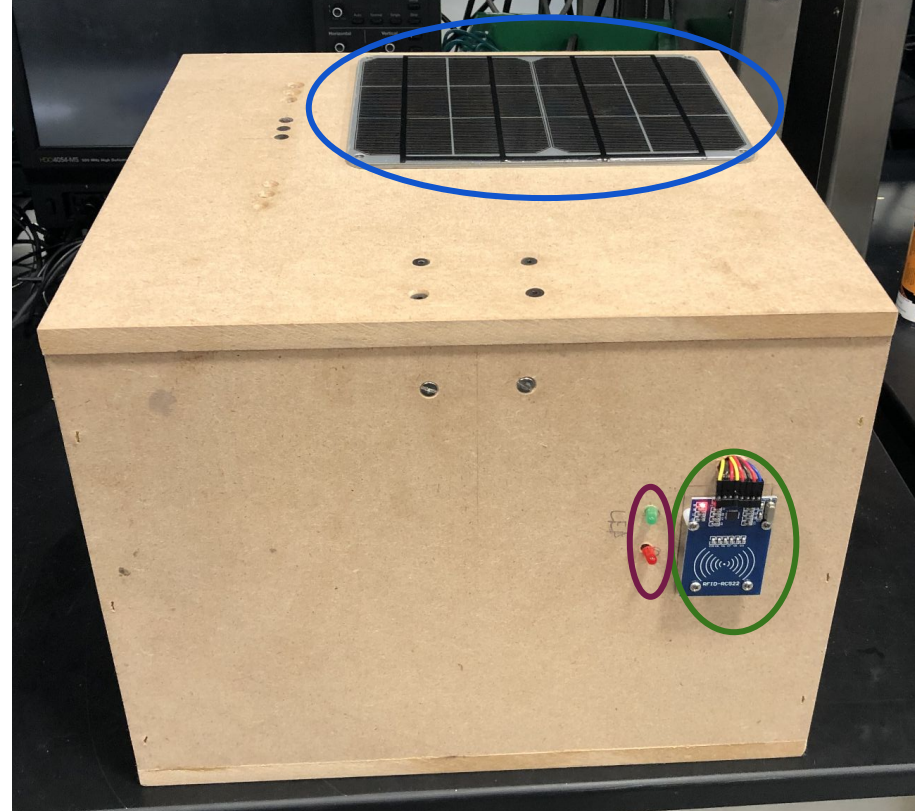
PCB Design

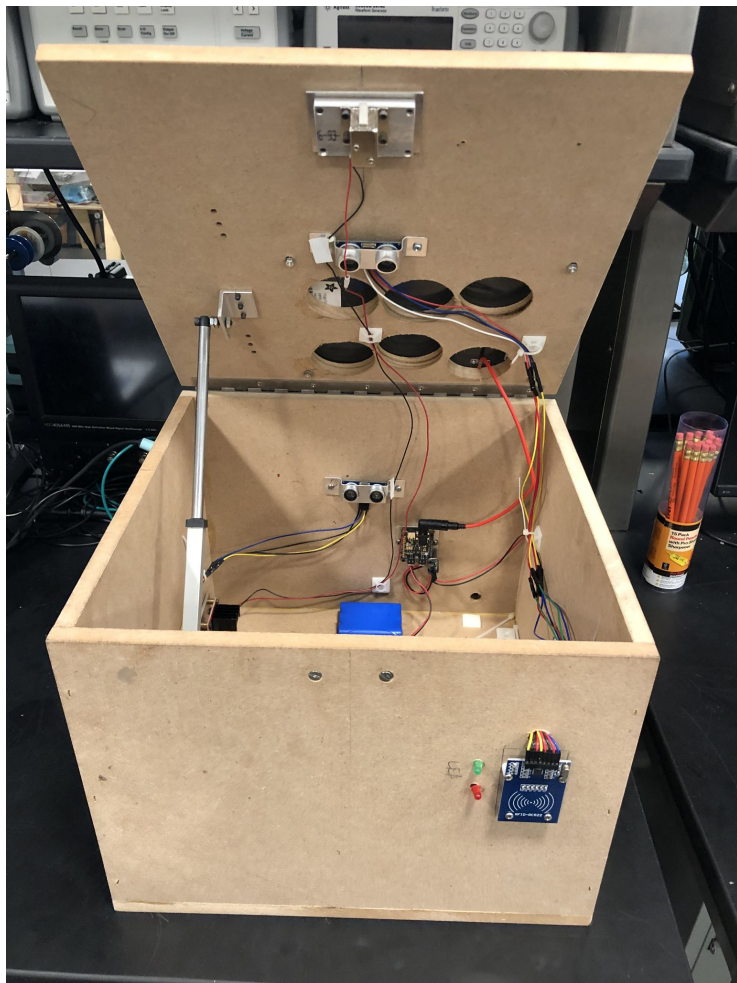
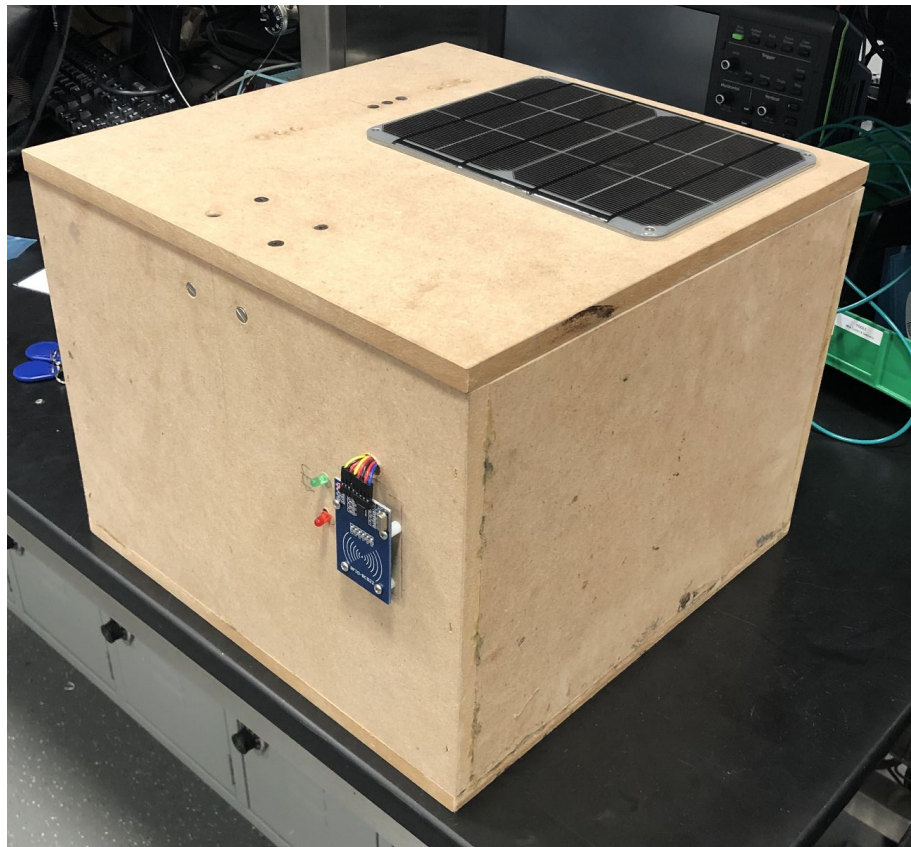


- Fullness (Ultrasonic) Sensors
- Power Unit (Solar Powered Battery)
- Solenoid Lock (Locking System)
- Lid Opener (Linear Actuator)
- Control Unit (PCB)

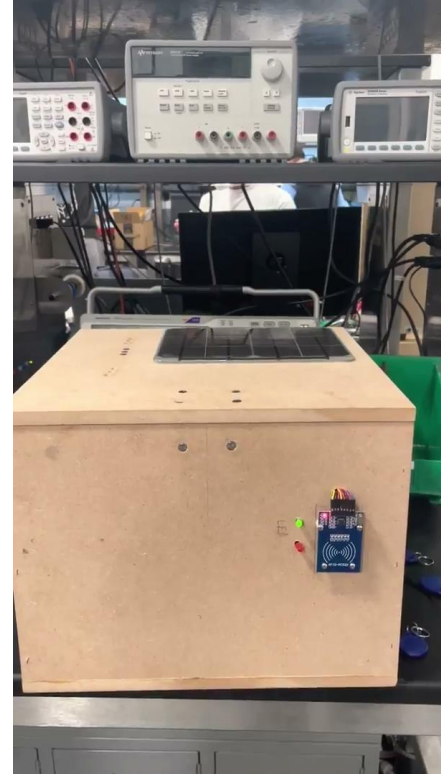
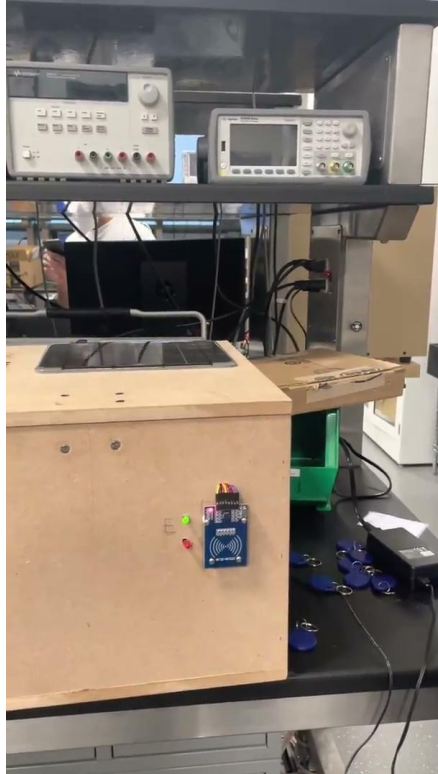


- **Power Unit (Solar Panel)**
- **RFID Sensor (Input)**
- **LEDs (Output)**



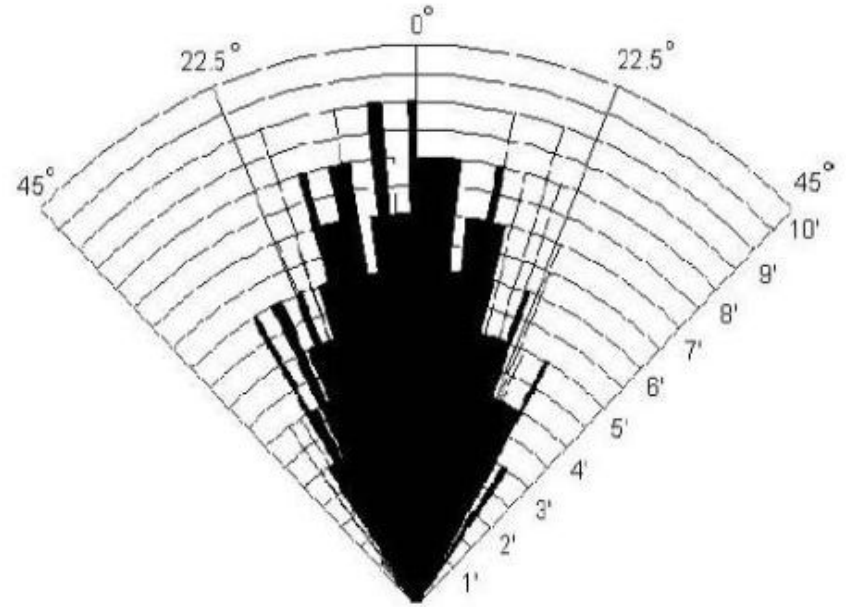


Short Demo



Challenge

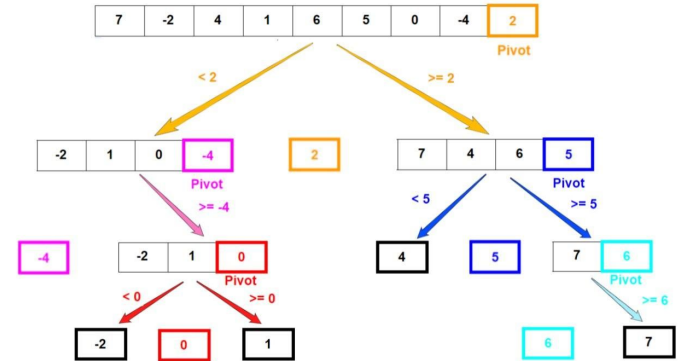
- HC-SR04 Ultrasonic Sensors
 - Works Well only on Hard surface with 0 degree angle
 - On soft surface, it is prone to many deceptive readings
 - Oftentimes, it would read 20 cm for distance of 5 cm at a steep angle



Practical test of Performance

Solution

- Finding a median of 11 output reading
 - Use quicksort to sort the array
 - Find the median value and use that output
 - Led to more accurate results
 - Temporary Solution
- Better solution
 - Laser Sensor (TOF10120)
 - More accurate at small distances
 - Less prone to get off by angle
 - Higher Cost (10 times)



Further Work

- More accurate sensors
- Protective shield for components
- Default open state when battery is low

Question