Self-Cleaning Cat Litter Box

ECE445 Team #48

Chi Zhang, Jian Chen, Weiman Yan

TA: Xihang Wu

What is a Cat Litter Box?

- Sand Box
- Indoor
- Cats’ Toilet

Why Self-Cleaning ?

Products in the market

- Problems:
  - No protection
  - Manually control
  - Waste not sealed

Nature's Miracle

T48 Smart Cat Litter Box

T48 Smart Cat Litter Box

Hand Free

Harm Free

Hassel Free

Demonstration

Waste =

Cat =

Demonstration

Cat Litter Box

Box id:1234

need to clean	Is cat in the box?	Current net weight in the box
Yes	No	0.22

Clean

Recalibrate

Hand Free

- Two Modules
  - Waste Filter
  - Bag Sealer

Hand Free

Hand Free

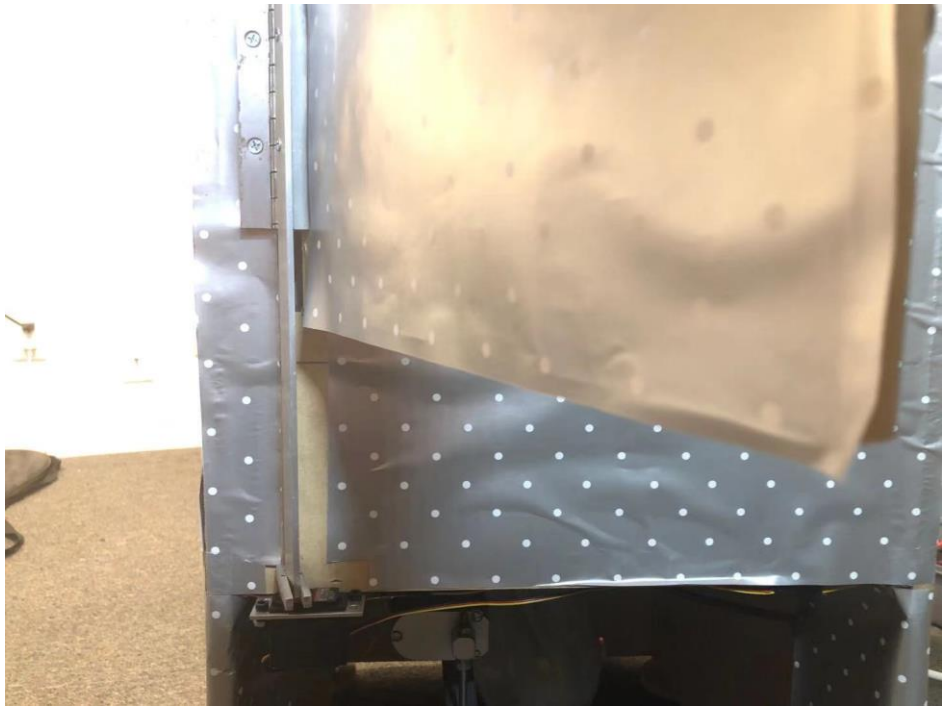
- 100% sealed
- Safe to use

Heat sealer

Hand Free

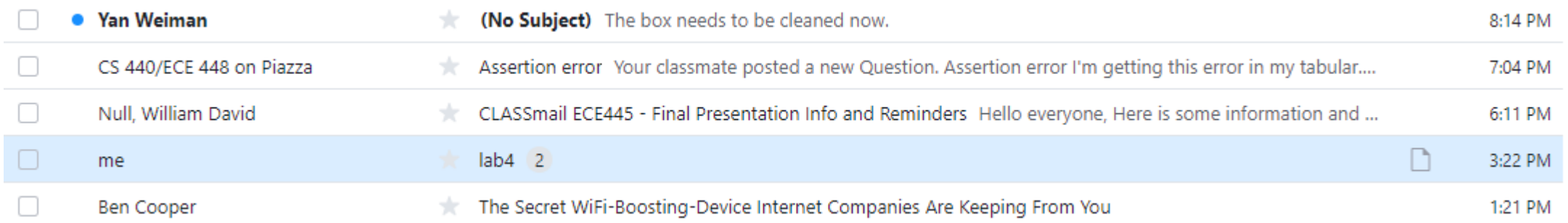
Harm Free

- Door would be closed during the cleaning process
- Weight sensors would detect whether your cat is in danger



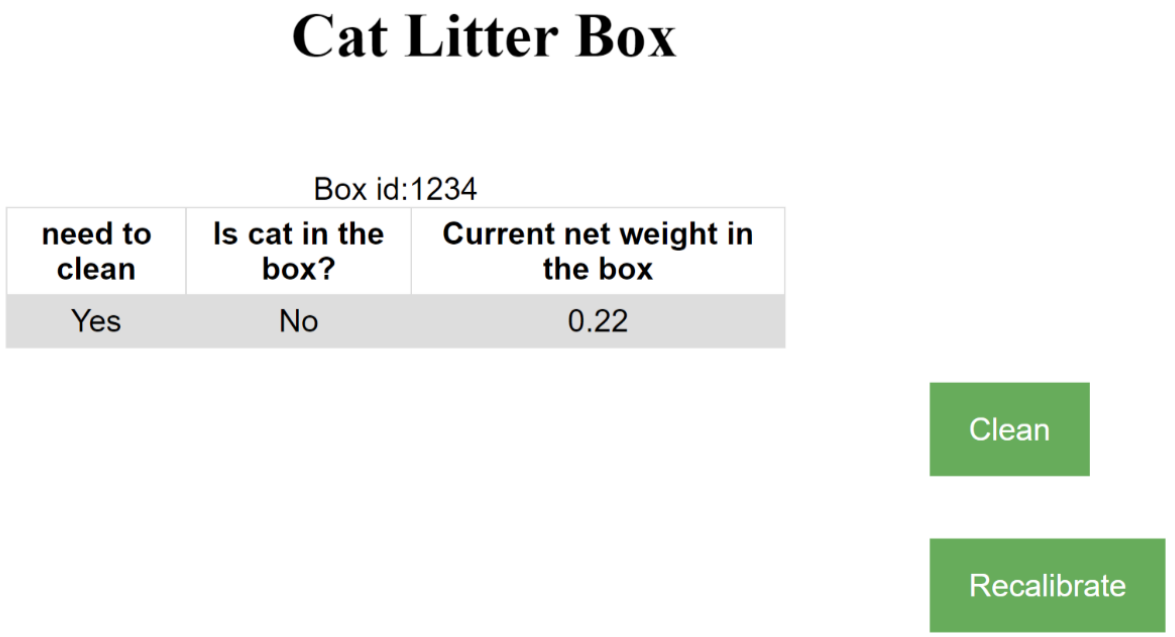
Hassel Free

- Email notification



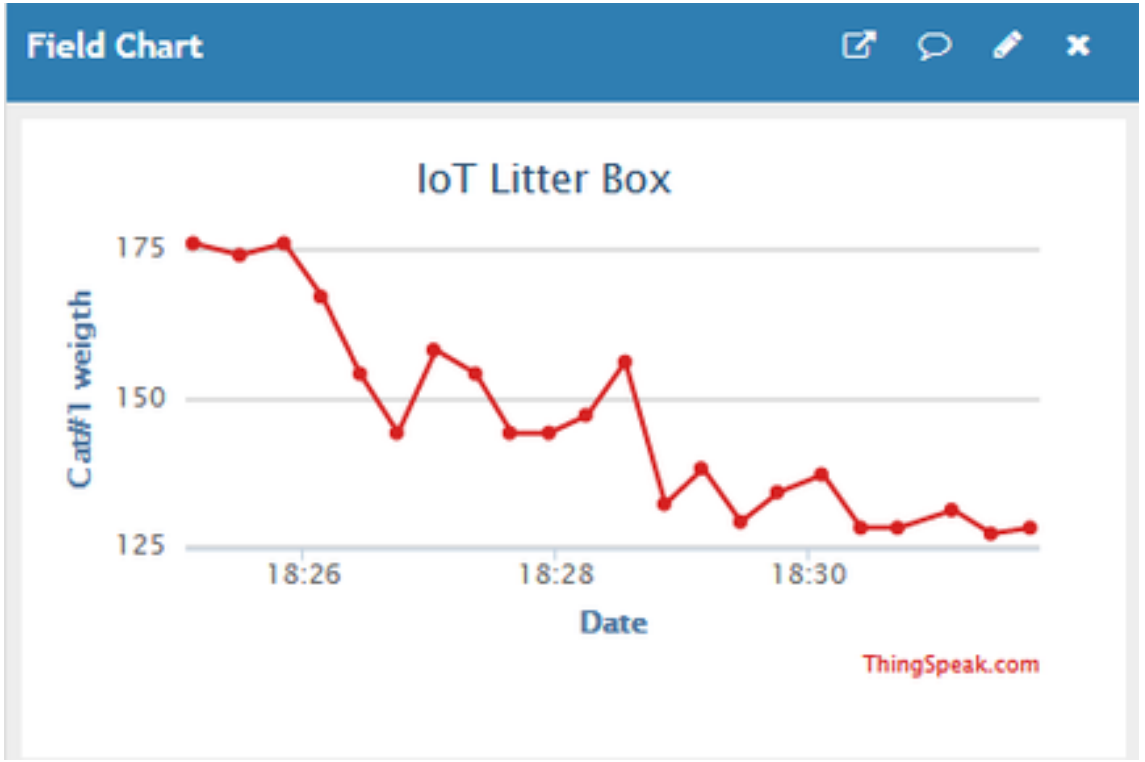
Hassel Free

- Email notification
- One button to clean

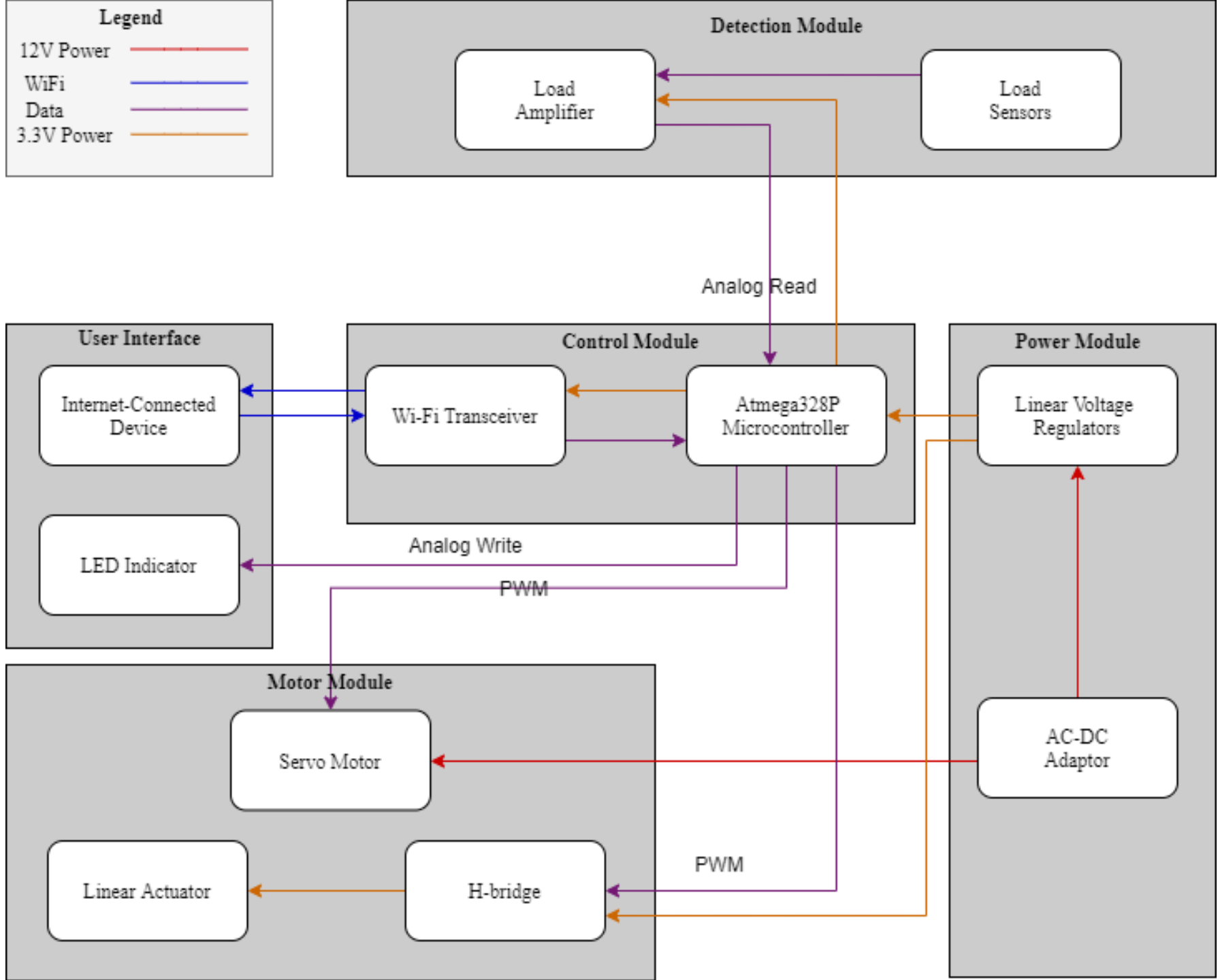


Hassel Free

- Email notification
- One button to clean
- Track your cat’s weight

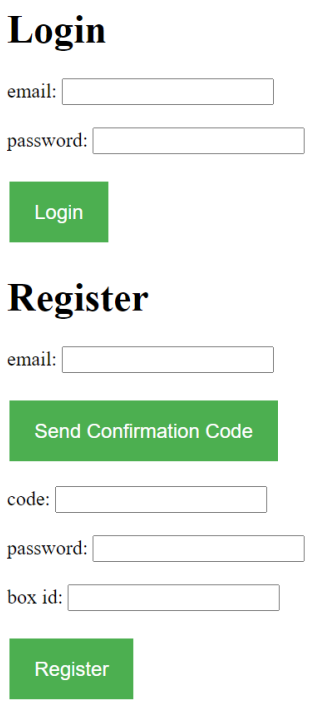


Cat On a diet


Legend
12V Power
WiFi
Data
3.3V Power
Detection Module
Load Amplifier
Load Sensors
Analog Read
User Interface
Internet-Connected Device
LED Indicator
Control Module
Wi-Fi Transceiver
Atmega328P Microcontroller
Analog Write
PWM
Power Module
Linear Voltage Regulators
AC-DC Adaptor
Motor Module
Servo Motor
Linear Actuator
H-bridge
PWM

User Interface

- Login/Register Page



User Interface

- Control Page

User Interface

Account Record


```
_id: ObjectId("6089a8c3f8917dd7a6ab0030")
email: "schuh4@illinois.edu"
password: Binary('Z0FBQUFBQmdpYWtiRklOZnJOcWNGaTVzQ201eVRodC1tZXJJQVd5cEIzWTJDMU15ckhxMXUtTkZoSnJoaVBSS0poS1NZYTVXdV94...', 0)
box_id: "1234"
code: null
```


Box Record

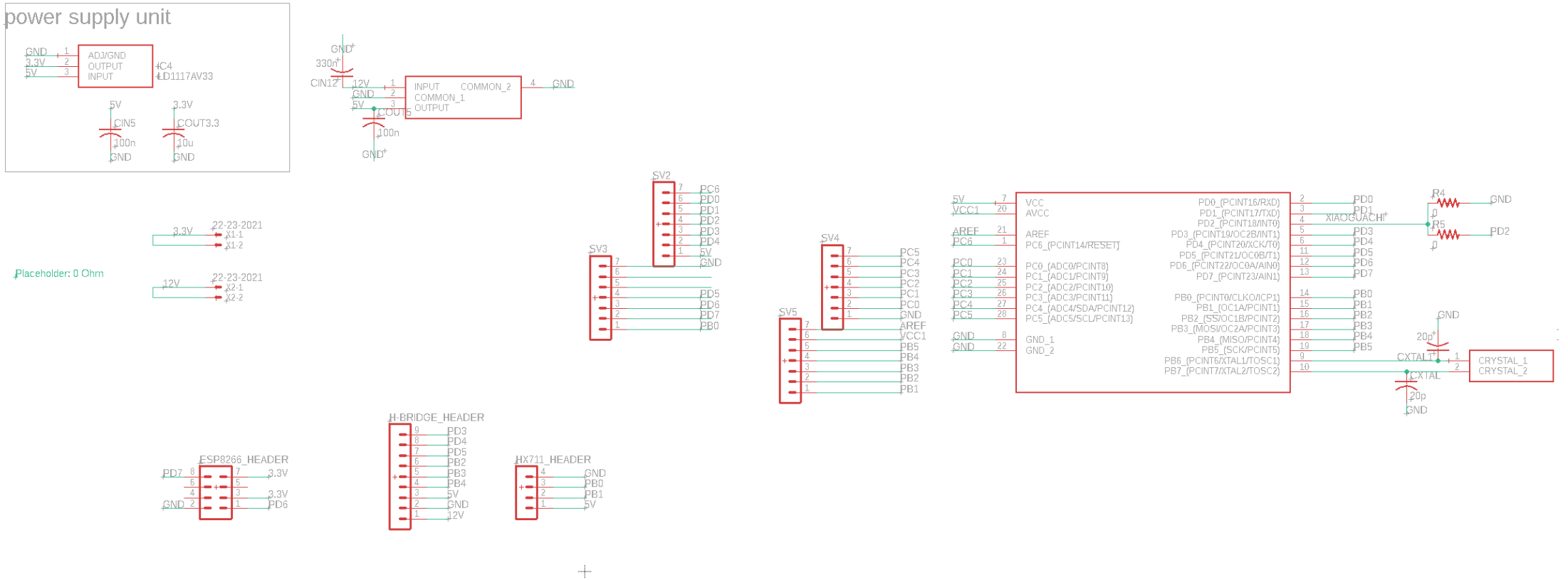

```
_id: ObjectId("607802a753a5014185767c4e")
box_id: "1234"
clean_channel: "1334092"
clean_api: "NEE29VXVIUC9R49C"
weight0_channel: "1334119"
weight0_api: " F2TB2I8HKYOAZCI6"
weight1_channel: "1334121"
weight1_api: "7ABSXA7HQ9HSBTGS"
recalibrate_api: "OSCU3N7IN6F3OYXM"
```

User Interface

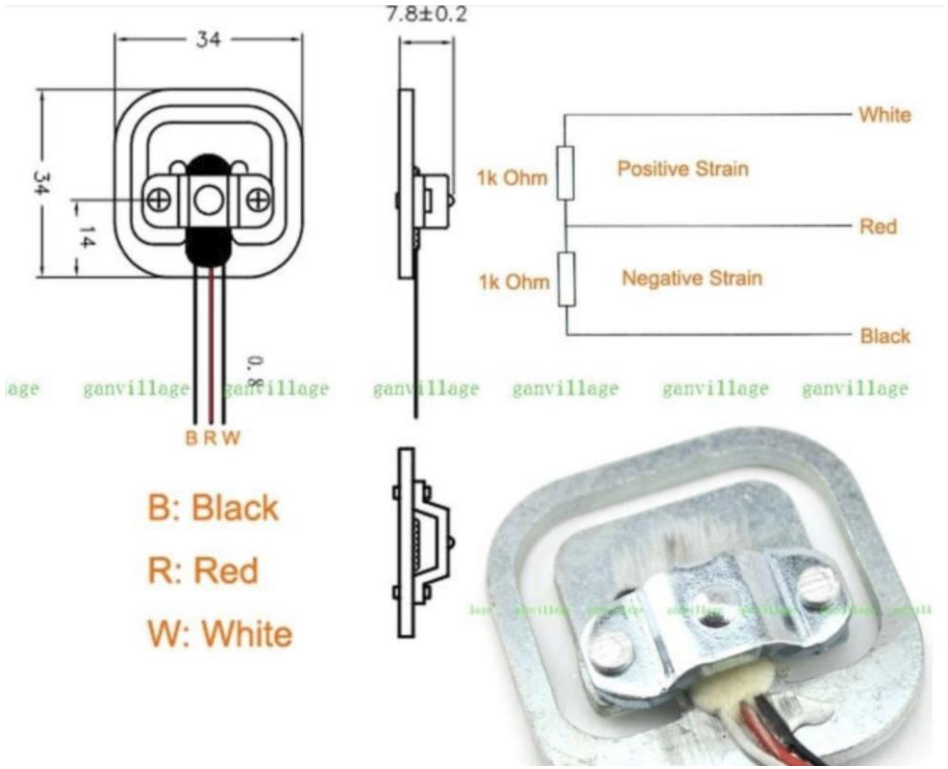
- Logic and Calculation

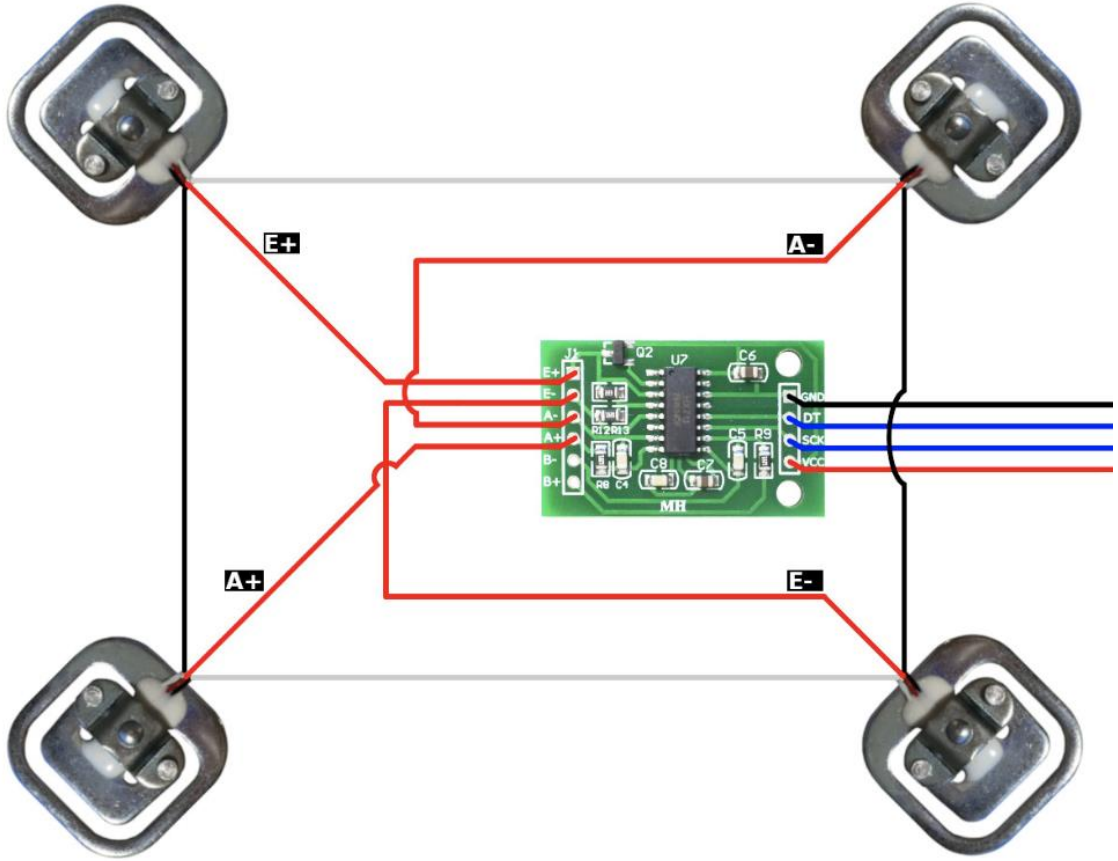
- Current Net Weight = Current Weight – Recalibrated Weight
- Current Net Weight > Threshold2 (4 lbs) ➔ Cat is in the box
- Last two Measurements of the Net Weight have the difference within 0.1 lbs ➔ The box is stable
- (Threshold1(0.2 lbs) < Current Net Weight < Threshold2 (4 lbs)) && (The box is stable) ➔ Need to Clean

PCB Design


power supply unit
GND
3.3V
5V
ADJ/GND
OUTPUT
INPUT
IC4
LD1117AV33
CIN5
100n
COUT3.3
10u
330n
CIN12
COUT5
INPUT
COMMON_2
COMMON_1
OUTPUT
SV2
SV3
SV4
SV5
PC6
PD0
PD1
PD2
PD3
PD4
PD5
PD6
PD7
PB0
PB5
PC5
PC4
PC3
PC2
PC1
PC0
AREF
VCC1
PB4
PB3
PB2
PB1
22-23-2021
Placeholder: 0 Ohm
ESP8266_HEADER
H-BRIDGE_HEADER
HX711_HEADER
VCC
AVCC
AREF
PC6_(PCINT14/RESET)
PD0_(PCINT16/RXD)
PD1_(PCINT17/TXD)
PD2_(PCINT18/INT0)
PD3_(PCINT19/OC2B/INT1)
PD4_(PCINT20/XCK/T0)
PD5_(PCINT21/OC0B/T1)
PD6_(PCINT22/OC0A/AIN0)
PD7_(PCINT23/AIN1)
PB0_(PCINT0/CLKO/ICP1)
PB1_(OC1A/PCINT1)
PB2_(SS/OC1B/PCINT2)
PB3_(MOSI/OC2A/PCINT3)
PB4_(MISO/PCINT4)
PB5_(SCK/PCINT5)
PB6_(PCINT6/XTAL1/TOSC1)
PB7_(PCINT7/XTAL2/TOSC2)
XIAOGUACHI
R4
R5
20p
CXTAL
CRYSTAL_1
CRYSTAL_2

Detection Module

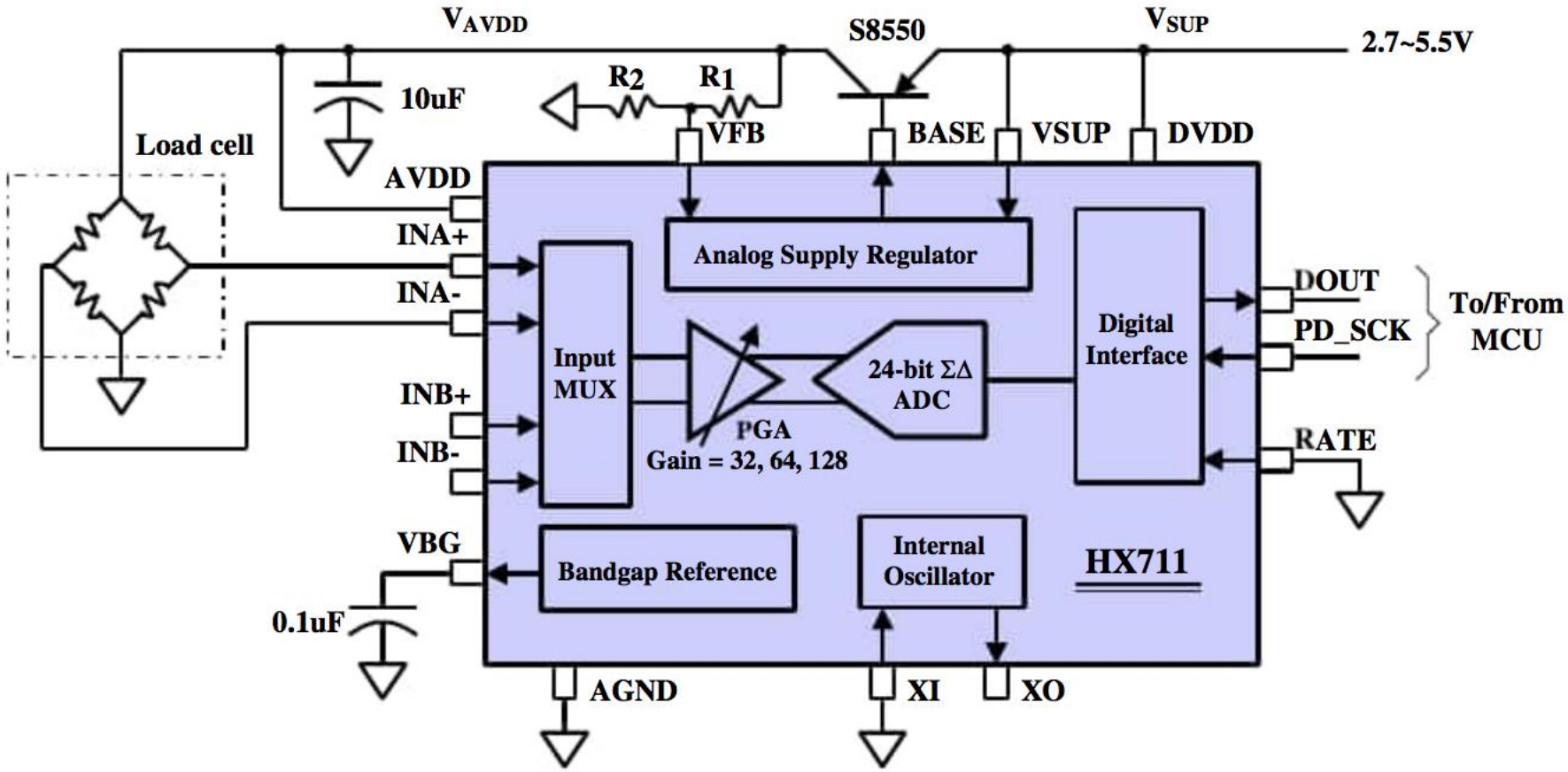




4 pcs load sensor with HX-711 amplifier

Detection Module

- HX711 is a precision 24-bit analog- to-digital converter (ADC) designed for weigh scales and industrial control applications to interface directly with a bridge sensor.

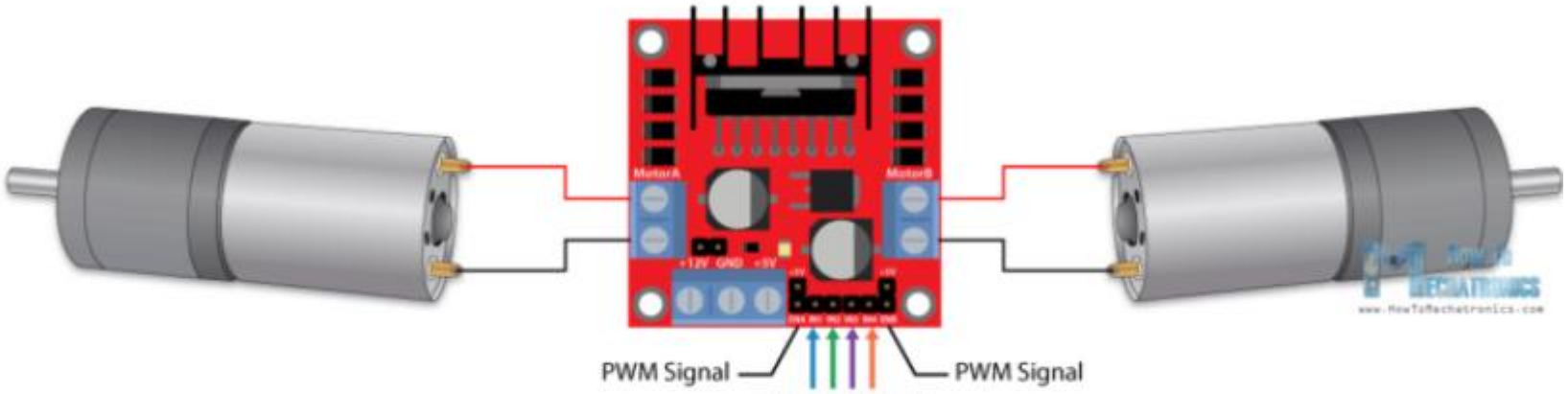


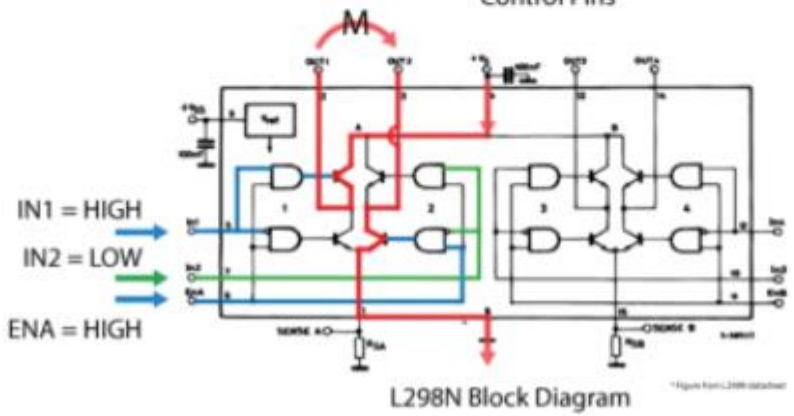
Hx711 circuit

- Actual Weight = Weight Transfer Slope * Input Resistance + Zero Weight Offset

Motor Module

- Rotatory Servo Motor
- Linear Actuator





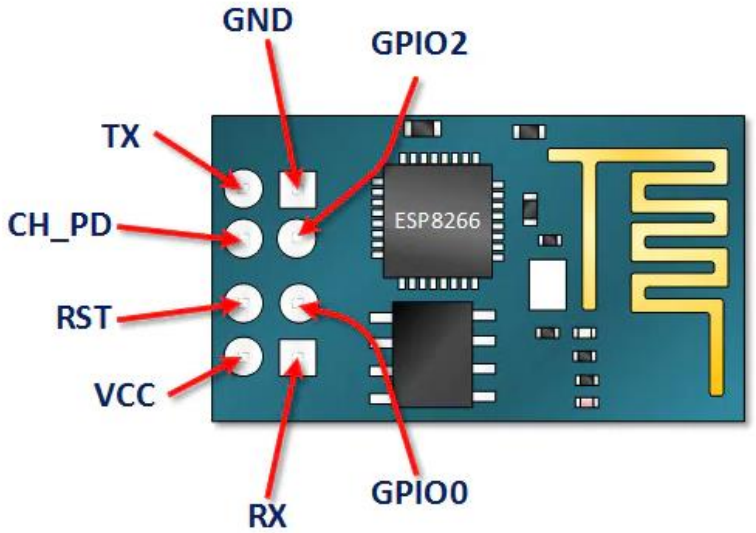
L298N Block Diagram

Linear Actuator

- Two 12 inches:
  - Fully extended length 105mm
  - Load capacity 1500N
  - Speed 4mm/sec
- One 2 inches:
  - Fully extended length 18mm
  - Load capacity 100N
  - Speed 50mm/sec

Control Module

ATMEGA328p



ESP8266-01

1KB EEPROM with 2KB SRAM

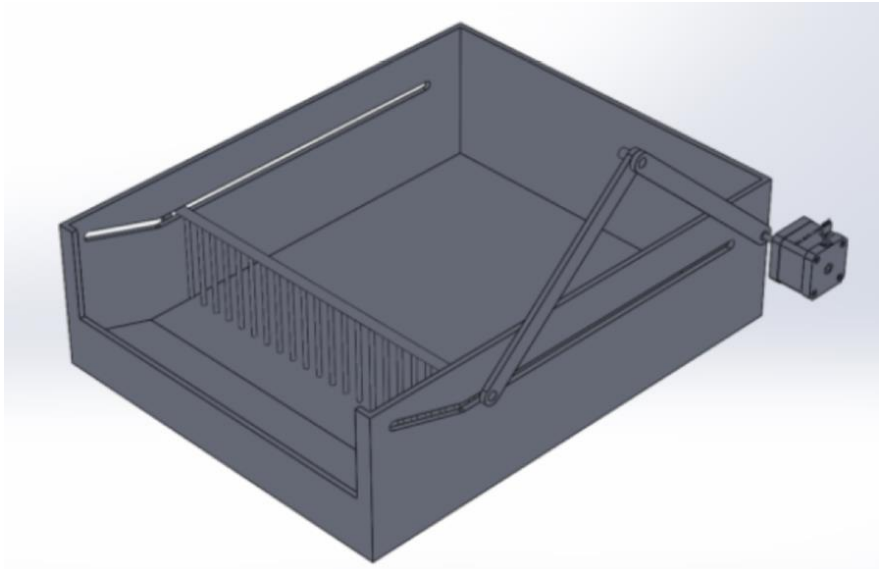
Read and write data every 20 seconds

Accomplishment

- IOT function
- Integrated microcontroller with motors and weight sensor to make sure safety.
- Motors work in sequence that can successful clean the waste and seal the bag
- Design our own remote web/App

Improvement

- Design and appearance
- Make it light in weight



Design

Gear Motor

Improvement

- Noise for the weight sensor → Make it stable

Improvement

- Data transmit too slow → More WI-FI Module
- Web/App improvement → Better appearance

Future work

- More sensors like IR sensors that can trace cats better.

- Find some ways like using robotic arm to automatically change the bag after sealing the bag.

Acknowledgement

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- Mengze Sha
- Daniel Shang

Reference

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Q & A

Thank you!