ECE 445 Senior Project

Smart Automatic Trash Basket

Team31: Suwon, Kaiyuan

Professor: Andrew Carl Singer

T.A: Lydia Marjure

Introduction

- 1.1 Features:

  Interesting Solution to an everyday life.

  Encourage more people to recycle.

  Practical uses but not too much power consuming.

- 1.2 Advantage:

  Being able to recycle automatically.

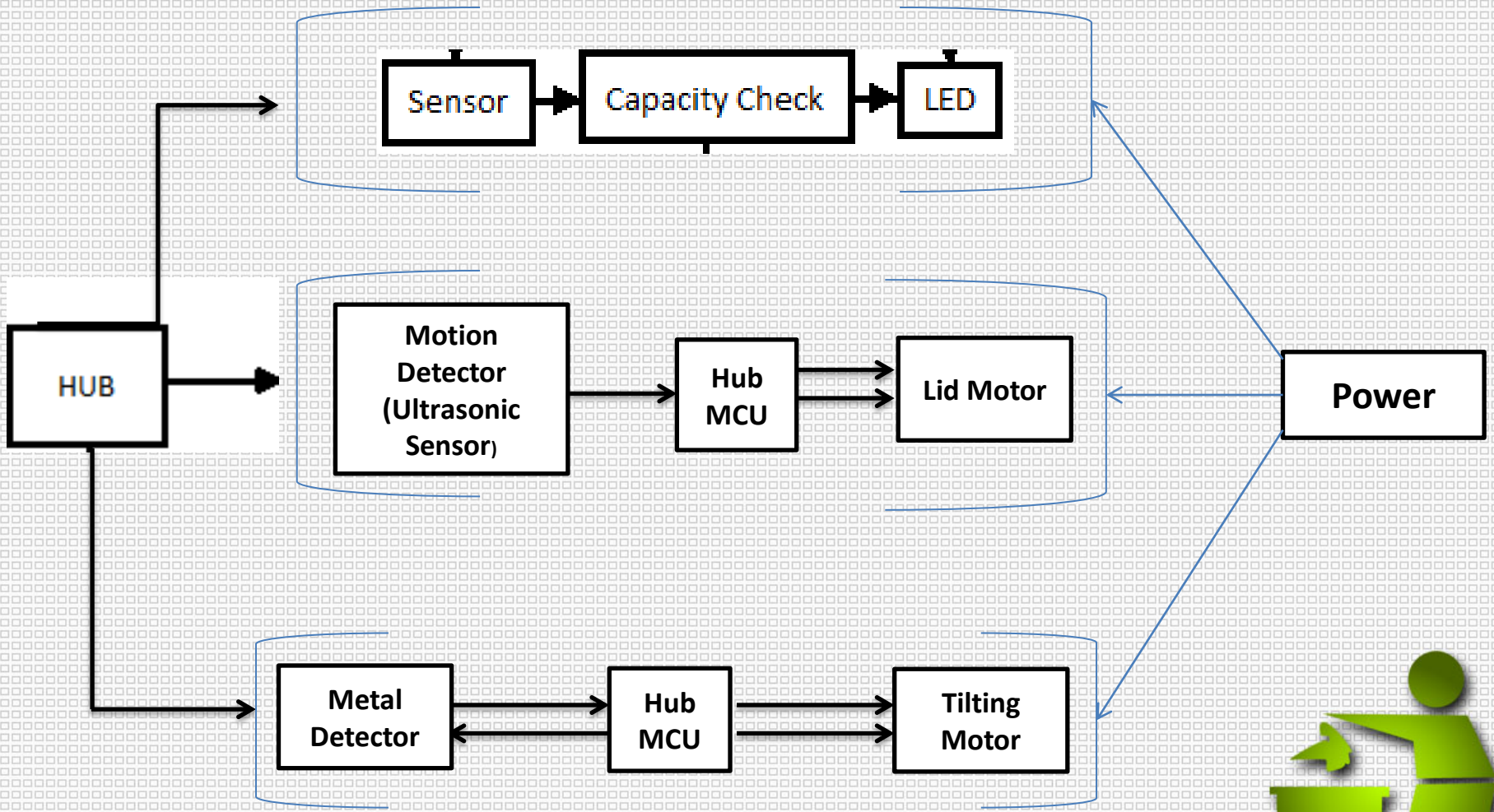
  Automatic lid for ease of use.

  Warning light when a basket is full.

- 1.3 Dimensions:

  Height: 21-5/8’’ Length: 13-3/8 ’’ Width: 9-13/16 ’’

System Overview



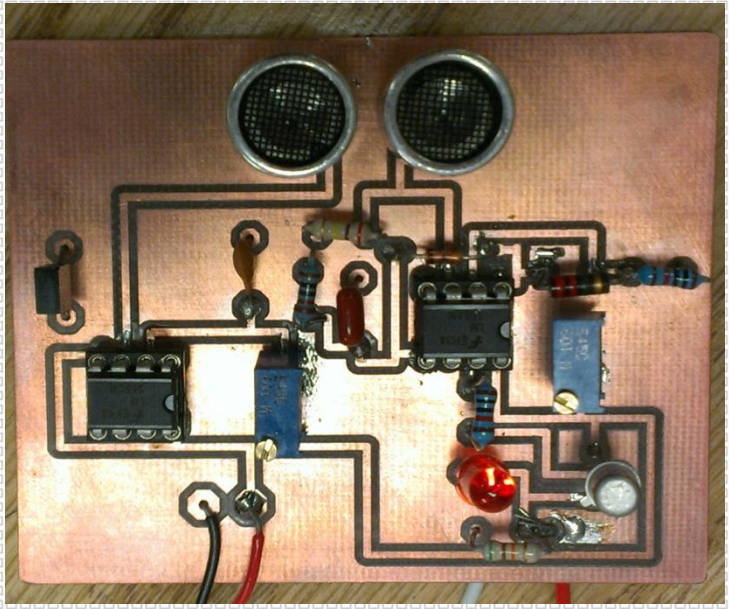
Hardware Overview

- Ultrasonic Sensor
- Metal Detector
- Tilting Motors (❶ Lid ❷ Sorting Plate)
- Capacity Check Parts (❶IR Sensor ❷IR LED ❸Comparator)

Motion Detector

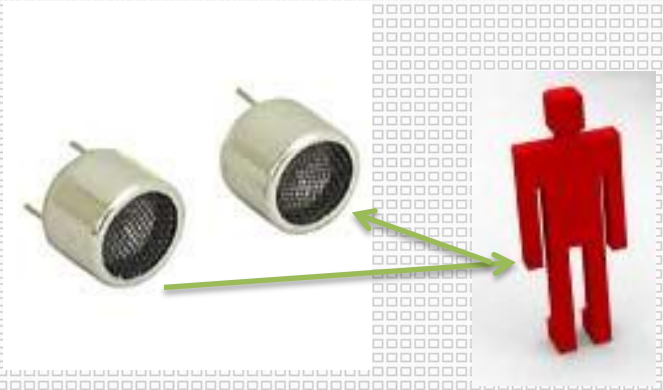
(Ultrasonic Obstacle Sensor)

Automatic Open/Close



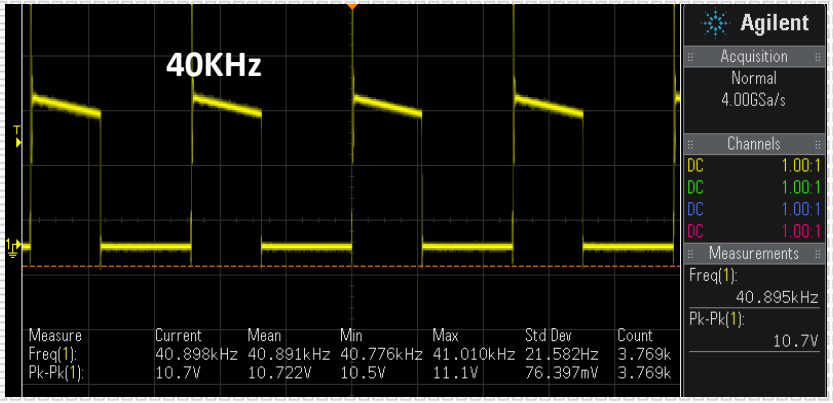
Sensor Features:

- Frequency: 40kHz ± 1.0kHz
- Aluminum case
- Sound pressure level: 112dB @ 40 ± 1.0kHz
- Sensitivity: 67dB @ 40 ± 1.0kHz
- Includes transmitter and receiver

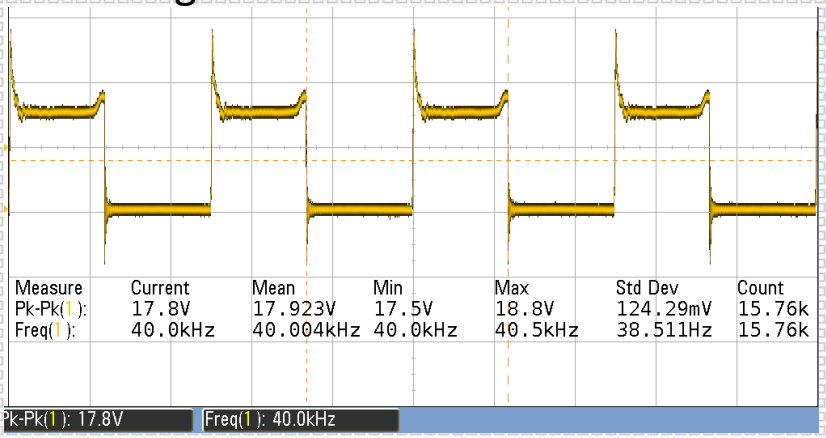


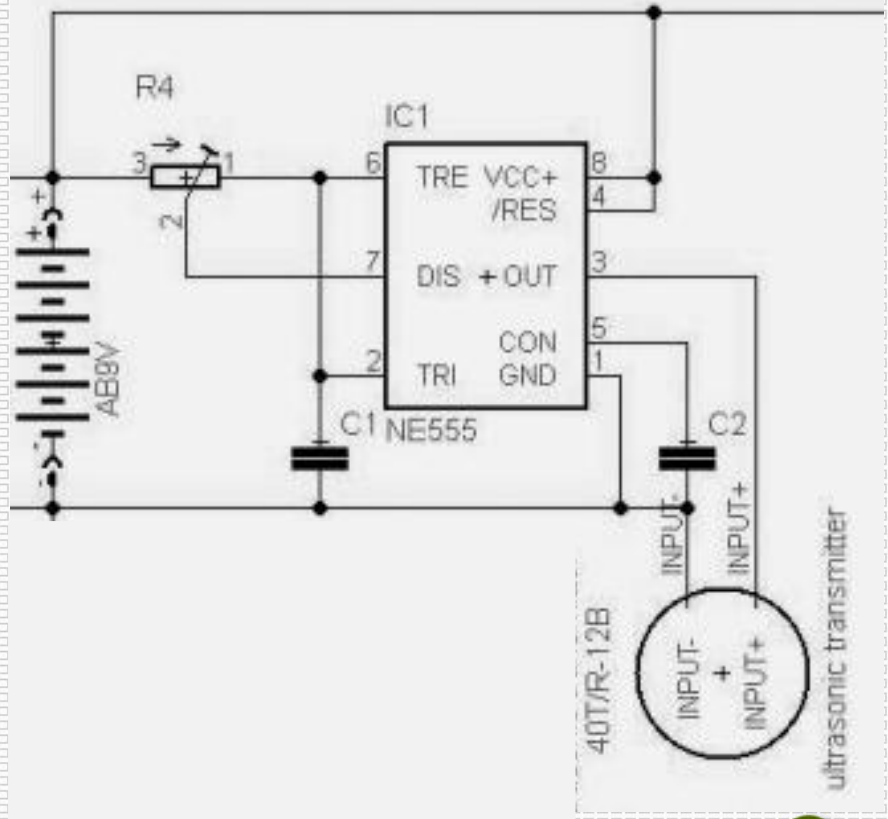
Signal Generator (Schematic)

Ideal signal wave@ output from breadboard



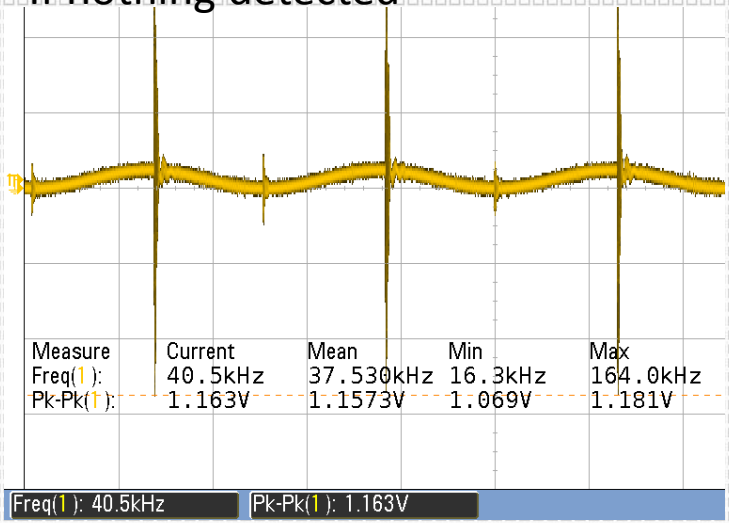
Actual signal wave on PCB



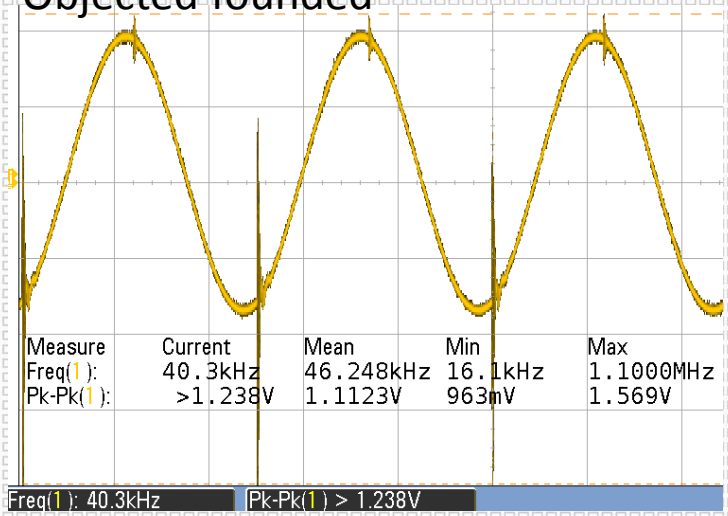


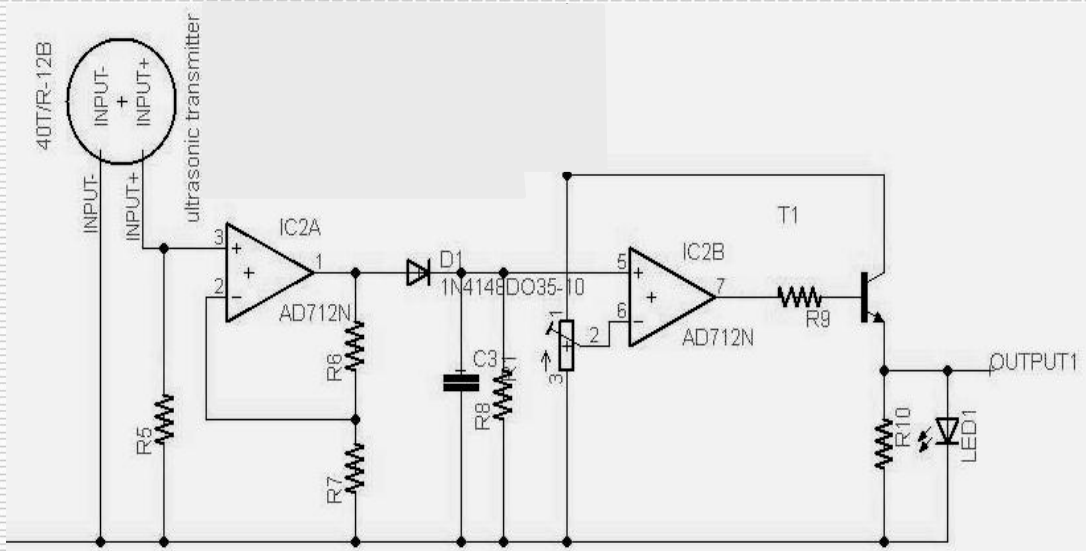
Signal Receiver (Schematic)

If nothing detected



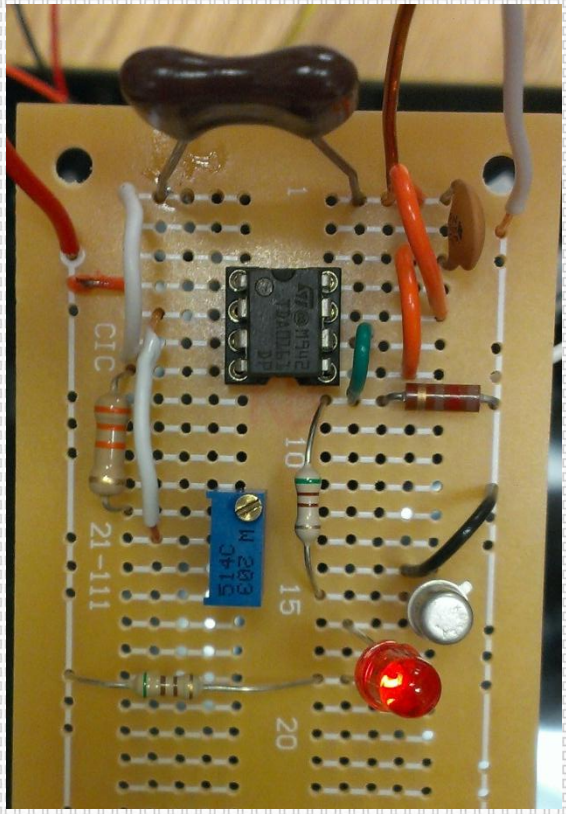
Objected founded





Metal Detector

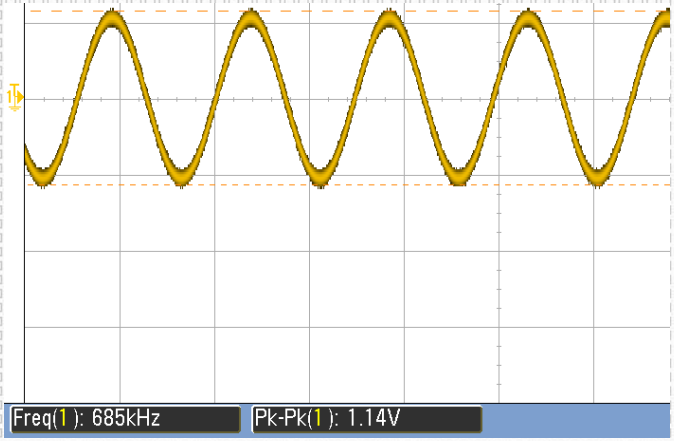
- Detect presence of any metallic object
- 2 analog signals(high/low) into MCU depending on the detection result
- Turning on/off LED depending on the detection result



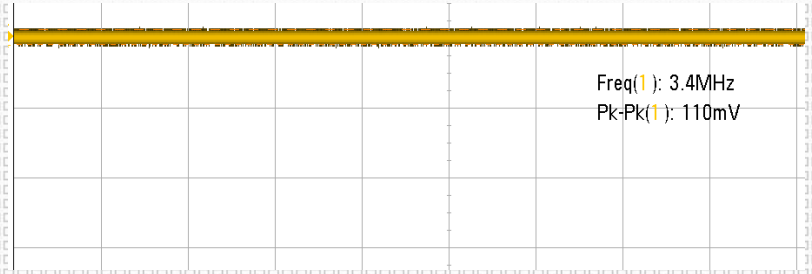
Schematic

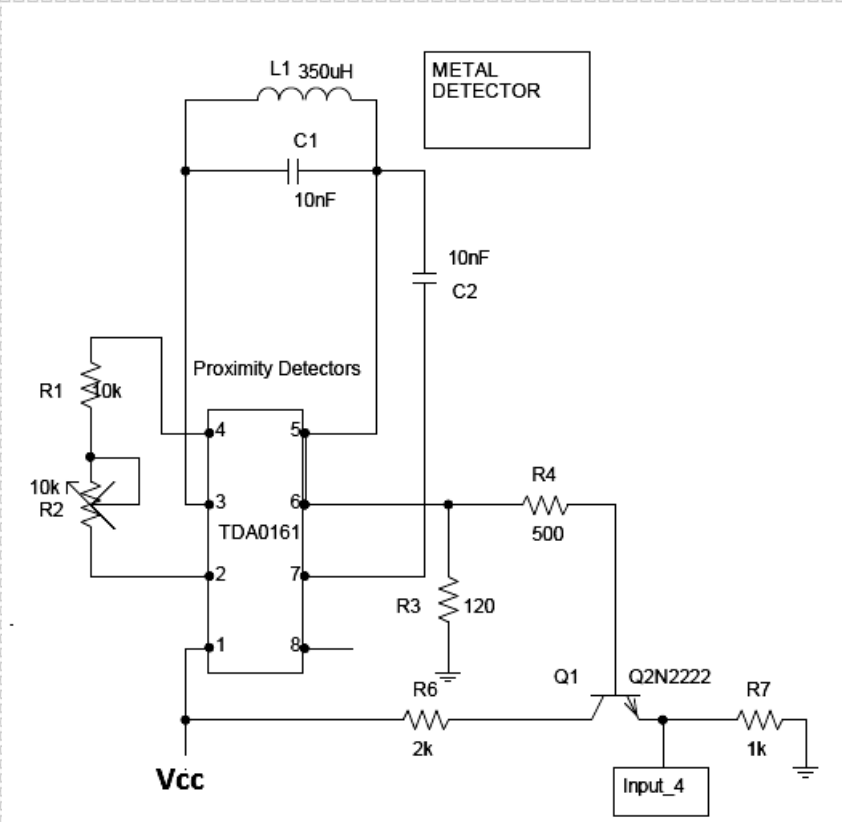
Core Signal (L1)

‘Empty’ when nothing detected



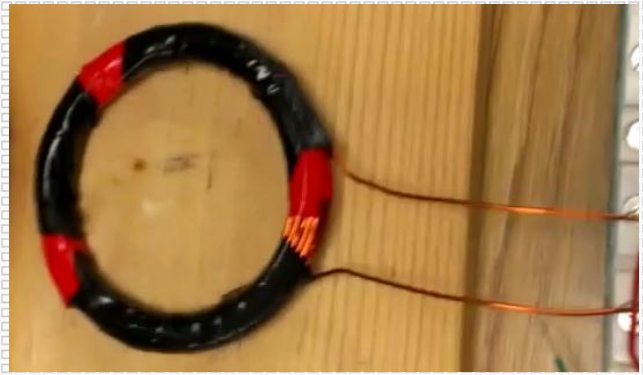
‘Full’ when metal detected

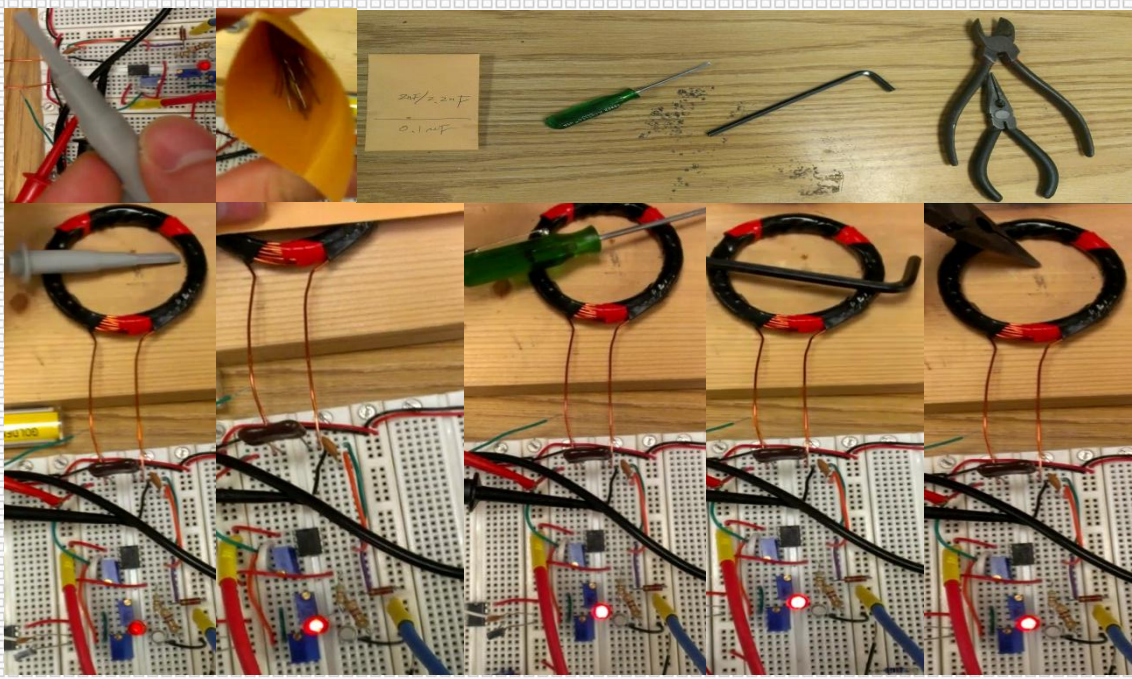




Detectable size of Metal

Smaller Core in breadboard testing
88uH



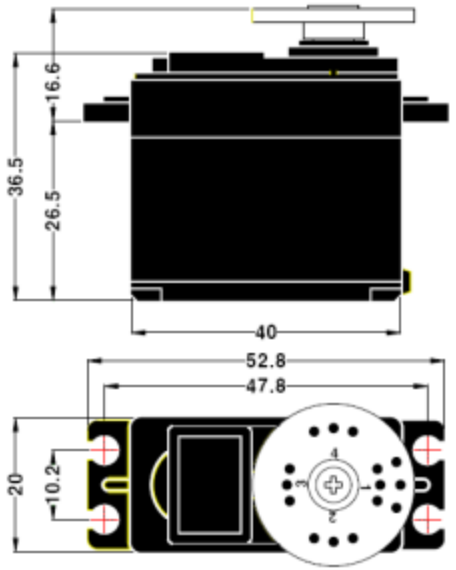


Bigger Core applied into basket
580uH

Bigger core increase the detection range but lower sensitivity to find out small metal objects

Tilting Motor

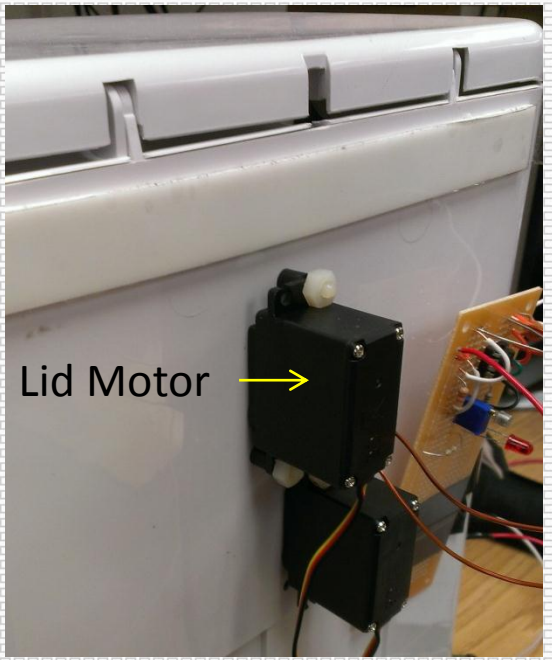
- **Control System:** +Pulse Width Control
  Required Pulse: 5 Volt Peak to Peak Square Wave
  Operating Voltage: 5.0 Volts
  Direction: Multi-directional
  Potentiometer Drive: 4 Slider/Direct Drive

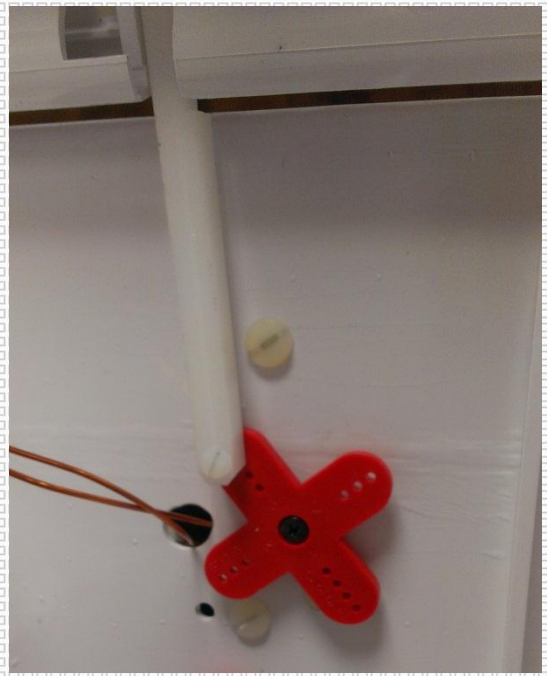


- Adjust duty cycle by MCU to control the angular position of motor. Represented in Lid/Sorting Plate Movement

Main Lid

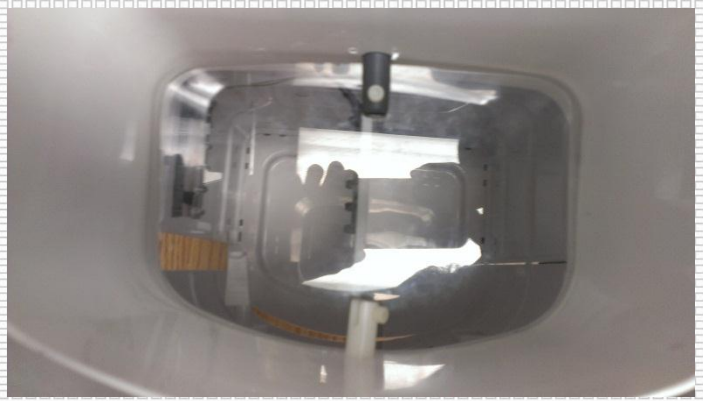
- Open - 10% Duty Cycle @50Hz
- Close – 4% Duty Cycle @50Hz

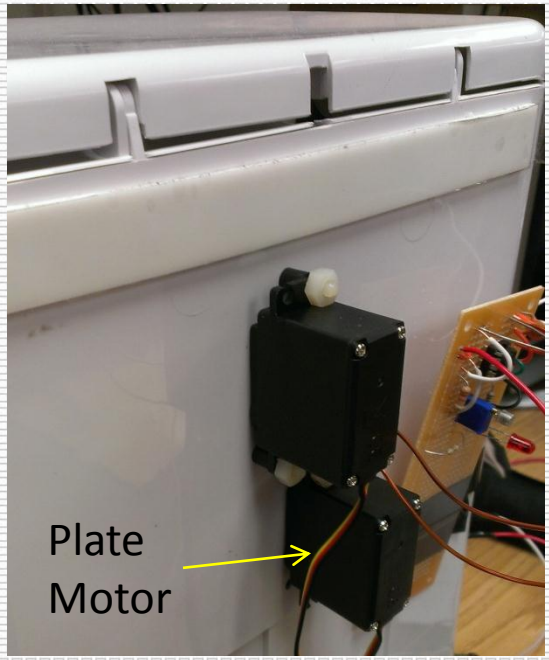


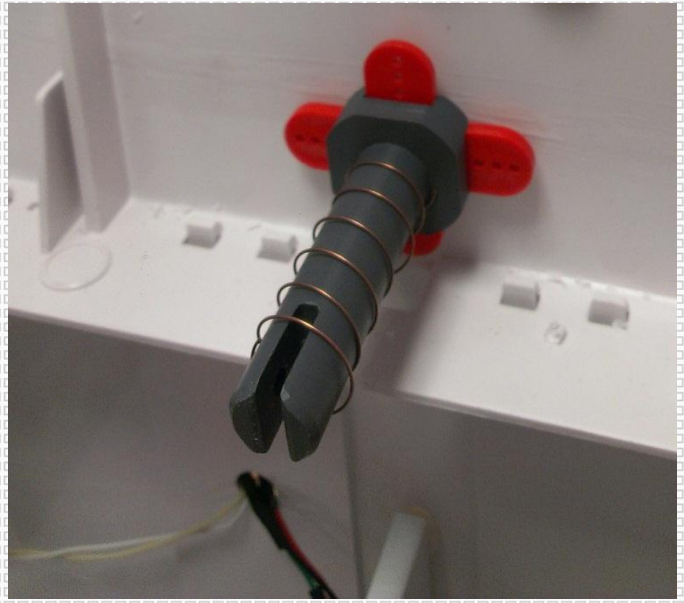


Sorting Plate

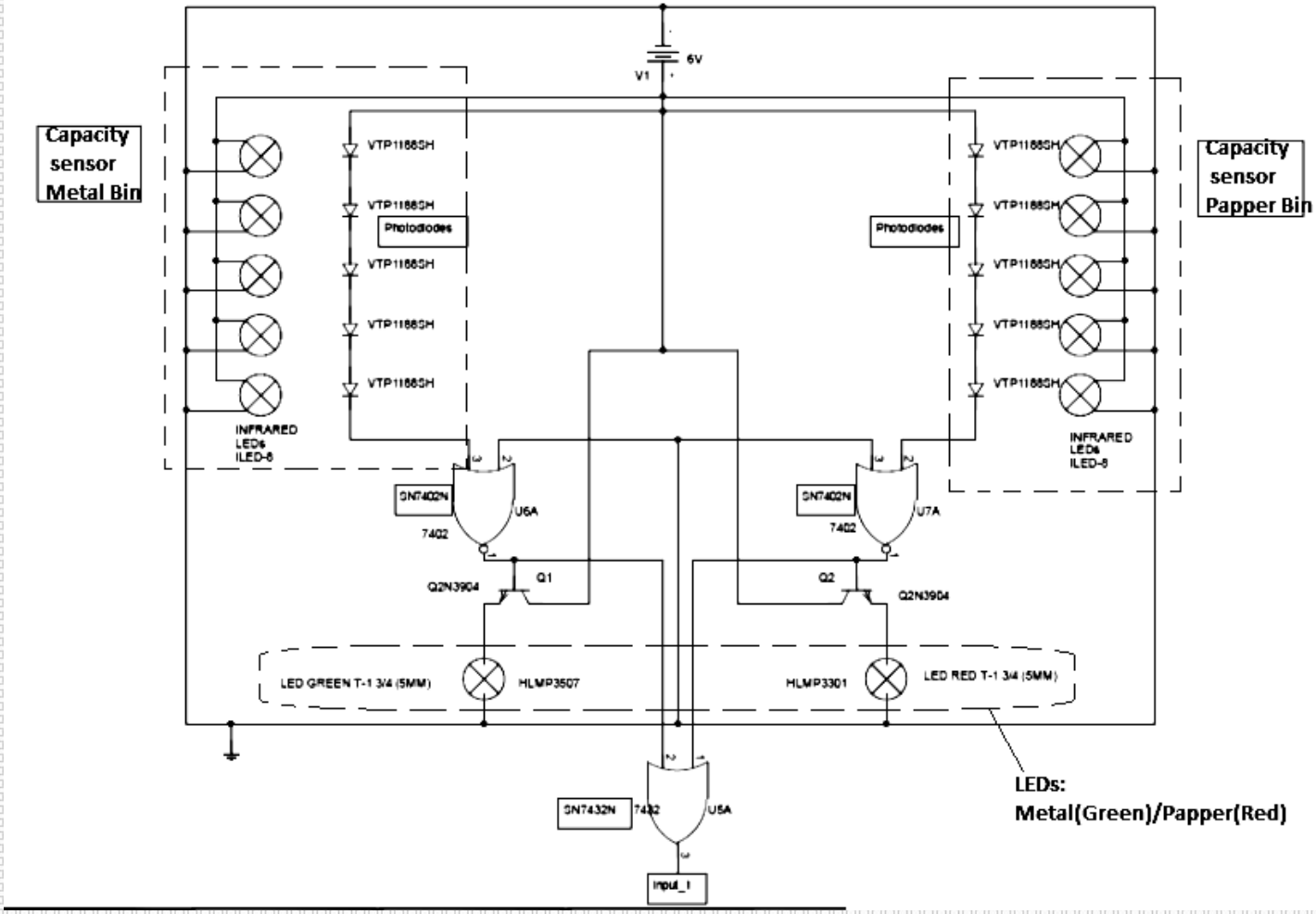
- 7.08’’ x 4.72’’ x 0.2’’
- Left – 35% Duty Cycle @ 500Hz (80 degree from center)
- Middle – 67.5% Duty Cycle @ 500Hz
- Right – 96.5% Duty Cycle @ 500 Hz



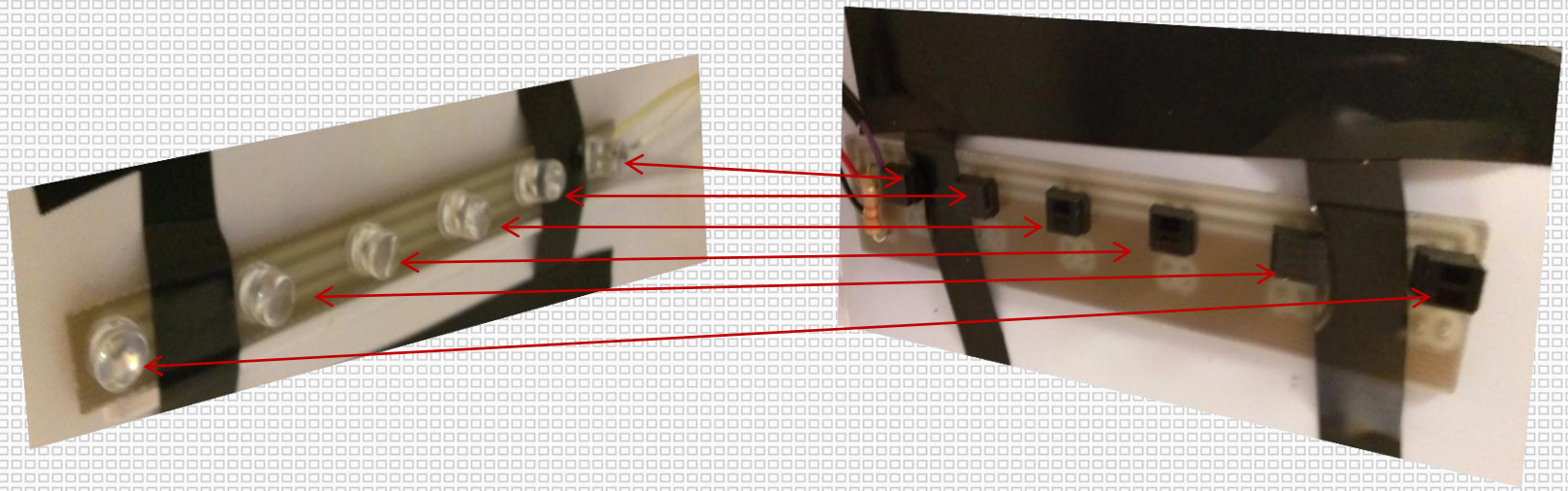




Capacity Check

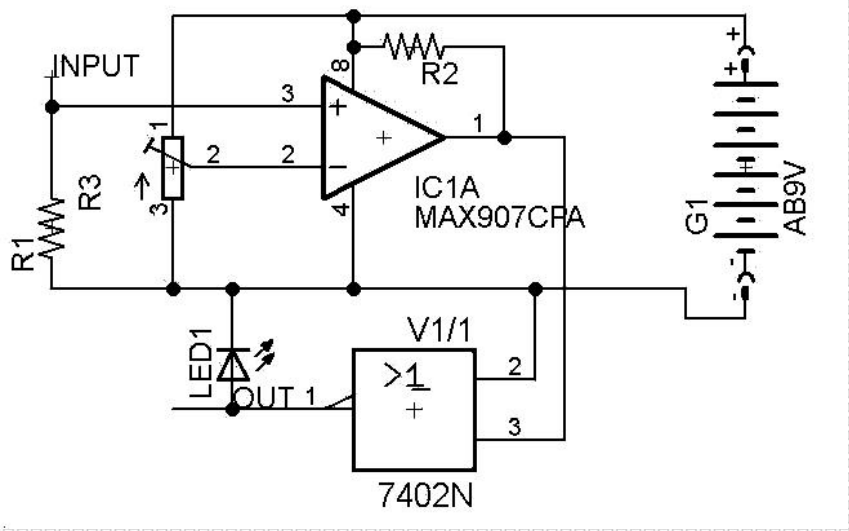


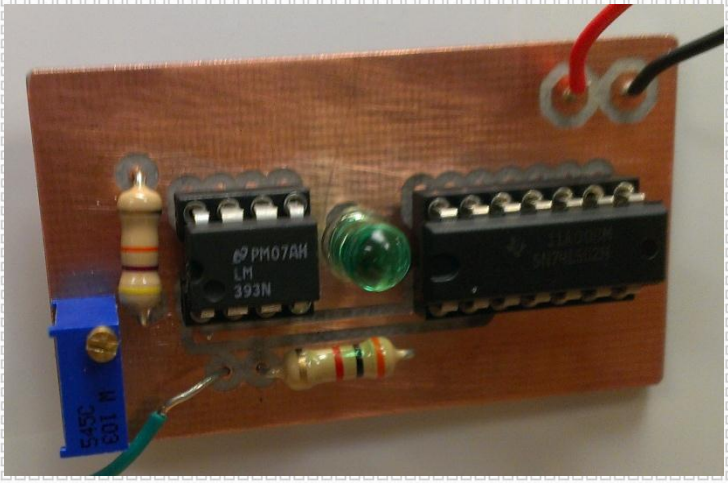
IR LED & Sensor Bar



- Face each other in same level
- Sensor bar output changing significant as any of these “Red Lines” are blocked

Logic Part





LED Turns ON when bin is full

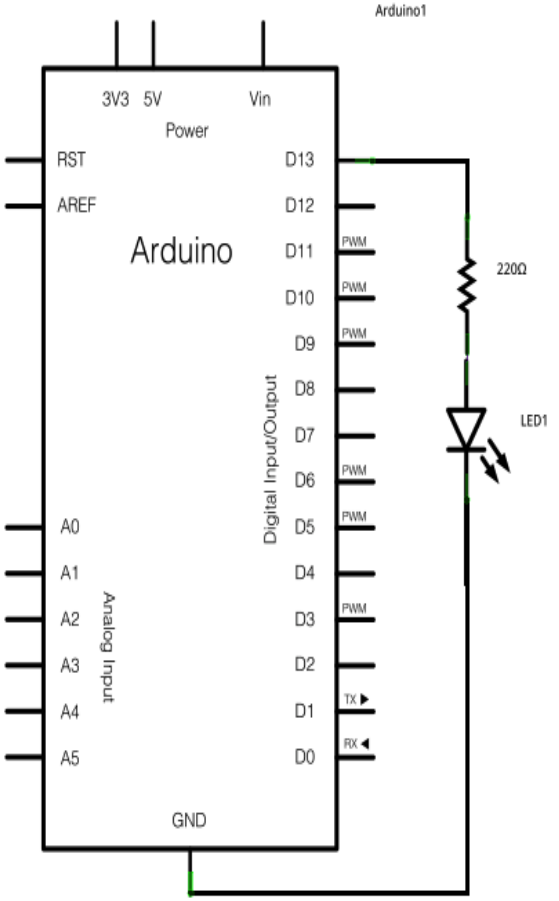
Software Overview

Arduino Uno

Pulse-width modulation is implemented on the Arduino.
Arduino is the Main Hub to control all parts together.

Advantages:
Can use any digital output pin.
Can have full control the duty cycle and frequency.
Can read analog signal from PCB output.

MCU Layout



- Analog input

A0: Motion Sensor Output

A1: Metal Detection Result

GND

- Digital Output

Pin13: Connected to main lid Servo Motor

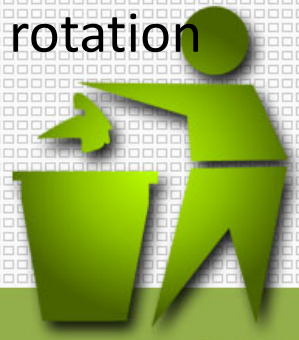
Pin12: Connected to tilting Servo Motor

Ground & Vcc

How to Operate

- 1. Read Input A0 into memory
- 2. If “High”, Output Pin13 with “OPEN”PWM to turn on Lid
- 3. Hold certain time(4sec) before close, then activate input A1
- 4. If A1 “High”, Output to Pin12 and let plate motor turn right; else, left
- 5. Output Pin12 with “Middle” PWM signal to recover the plate position
- 6. Loop again, be ready to read new A0 input

Challenge	Improvement
Fault Output Signal (Motion Sensor) due to vibration	Used sponge to absorb vibration & Added delay in the code
Sensitivity of Sensor	Adjusted variable resistor to change reference voltage
Alignment IR Sensor	Checked every voltage by moving it each time
Main Lid Weight	Used the most outside shaft to give full length of rotation



Strength

Mechanical Movement

1. Sorting Plate
2. Main Lid

Sensitivity

1. Sensitivity of Ultra-Sonic Sensor
2. Stable Capacity Check part

Weakness

Weak Wire Connection

Three different power Supplies
(1.4V, 6V, and 9V)

Each PCB part need cover for good looking

Insensitivity for small metal objects

Future Hardware Development

- Better track design on wire connection
- Regulation of different power needs
- Rearrange space to place PCBs
- Switch core to improve metal detection sensitivity

Ethical Issues

- 1.Responsibility for our Environment
- 2.Always be careful with potential consequence
- 3.Contructive criticism to give feedback
- 4.Teamwork and Members' relationship
- 5.WHY NOT ME?

Special Thanks

- Prof Singer, Andrew Carl
- T.A Majure, Lydia Lee

Parts Shop

- Skot P. Wiedmann
- Smart, Mark Wayne
- Smith, Waltham Lemuel