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:

System Overview

Motion Detector (Ultrasonic Sensor) -> Hub MCU -> Lid Motor

Power

Metal Detector -> Hub MCU -> Tilting Motor
Hardware Overview

- Ultrasonic Sensor
- Metal Detector
- Tilting Motors (① Lid ② Sorting Plate)
- Capacity Check Parts (① IR Sensor ② IR LED ③ Comparator)
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

Measure
Freq(1): 40.5kHz
Pk-Pk(1): 1.163V

Measure
Freq(1): 40.3kHz
Pk-Pk(1) > 1.238V

Current
Mean
Min
Max
40.5kHz
37.53kHz
16.3kHz
164.0kHz
1.1573V
1.069V
1.181V
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
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
LED Turns ON when bin is full
Software Overview

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 (4 sec) 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**

- Fault Output Signal (Motion Sensor) due to vibration
- Sensitivity of Sensor
- Alignment IR Sensor
- Main Lid Weight

**Improvement**

- Used sponge to absorb vibration & Added delay in the code
- Adjusted variable resistor to change reference voltage
- Checked every voltage by moving it each time
- 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. Constructive criticism to give feedback
4. Teamwork and Members’ relationship
5. WHY NOT ME?
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