Bio-hazard Waste Bin

Group 36
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ECE 445 Senior Design
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Introduction

- Handle medical or laboratory waste Effectively and Safely
- Display message on the LCD screen to notify all possible situations
- Minimize the chance of infection using heat-sealing technology

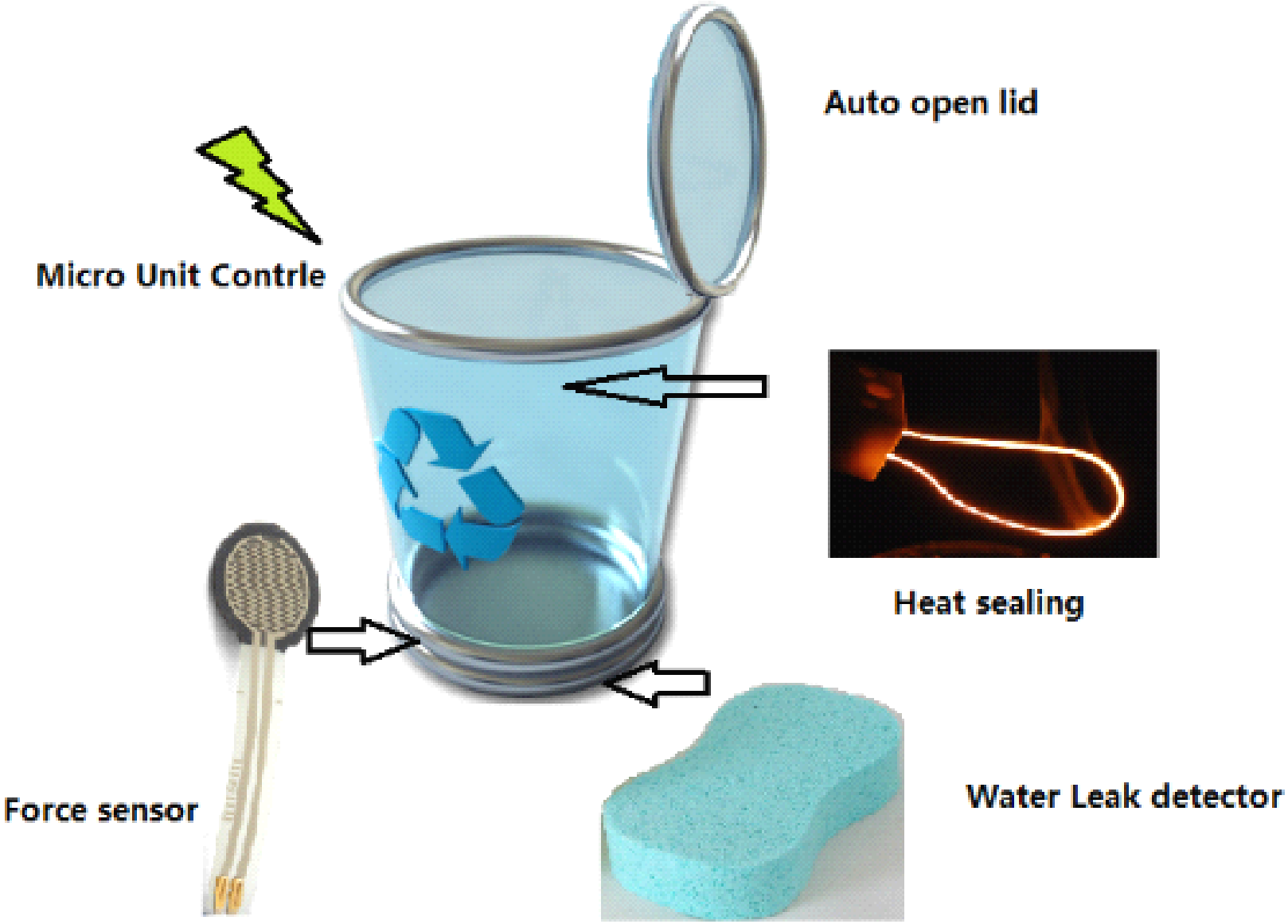
Features

- Detect disposal action

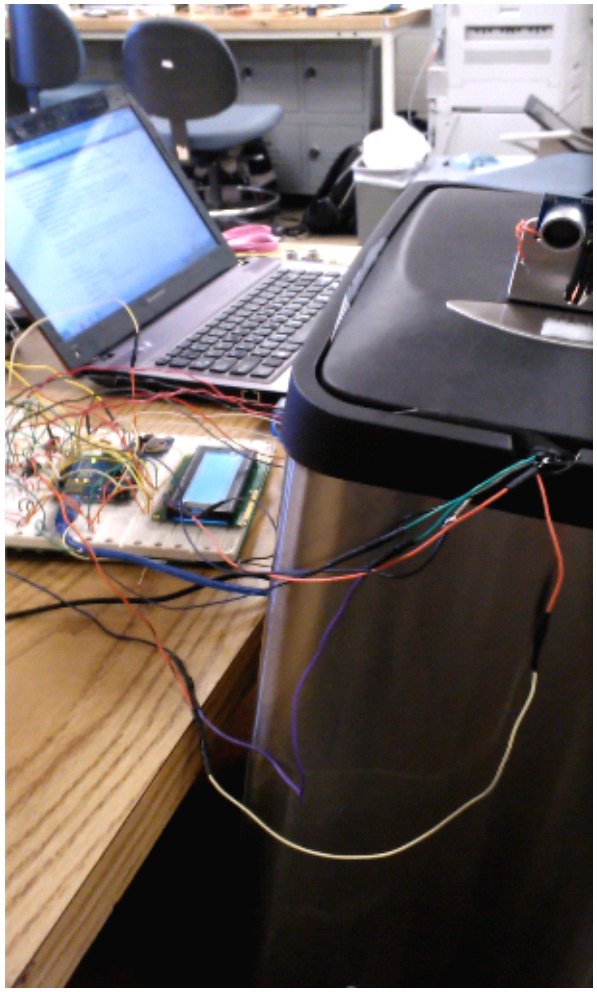
Auto-open lid

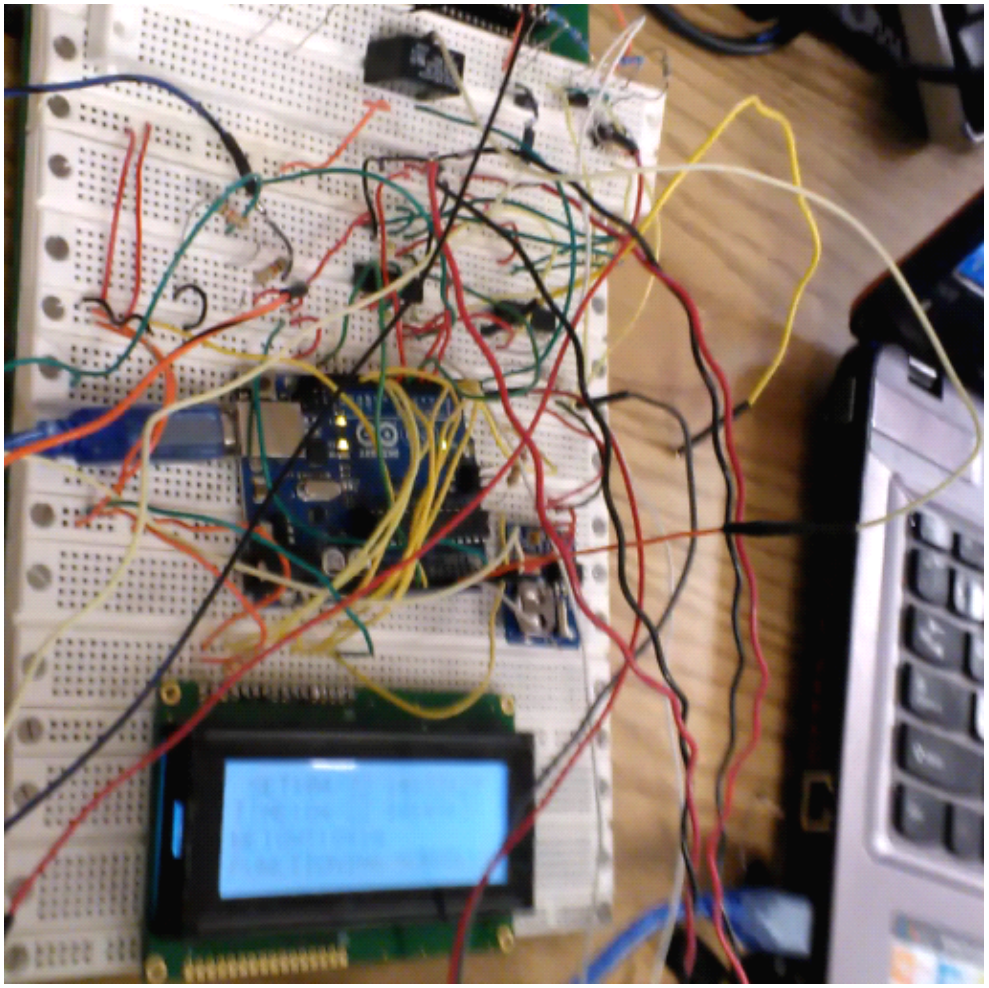
- Water leak detection in the trash can
- Auto heat seal the trash bag when instructed by MCU
- LCD Displays date, weight and state of the trash and warning if leakage happens

Design of inside

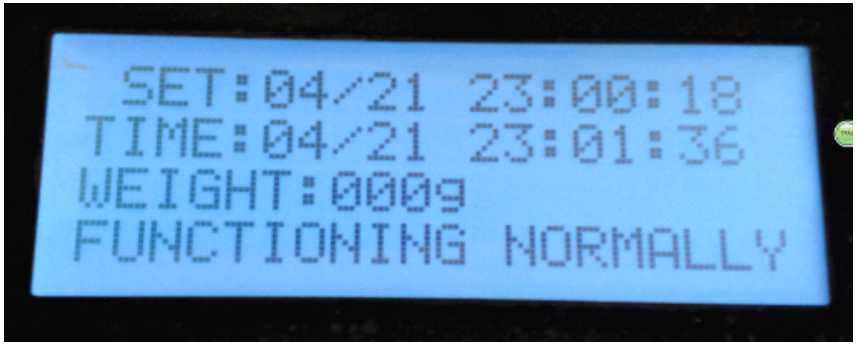


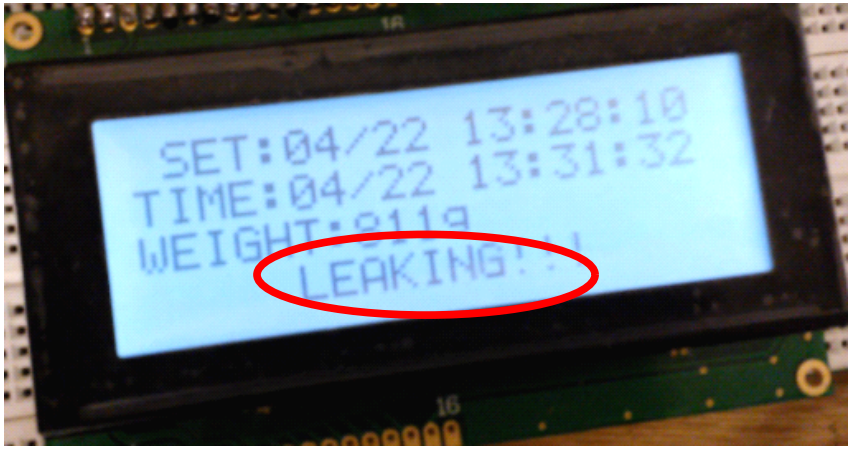
Project Overview

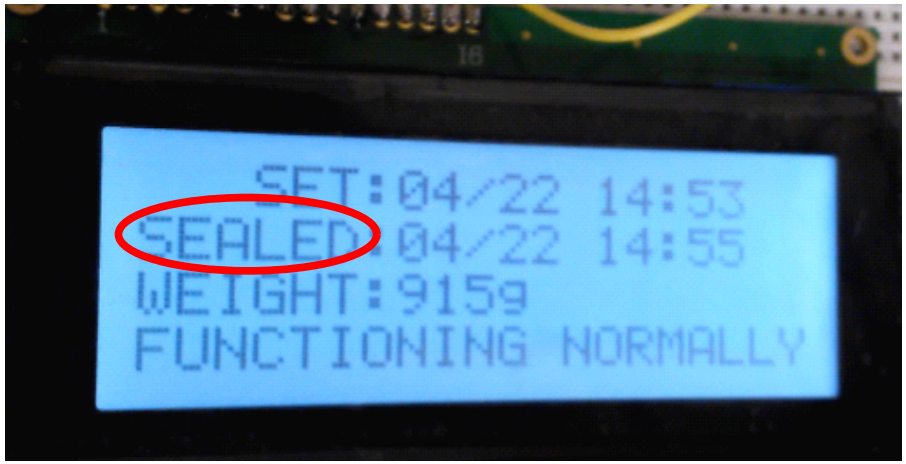




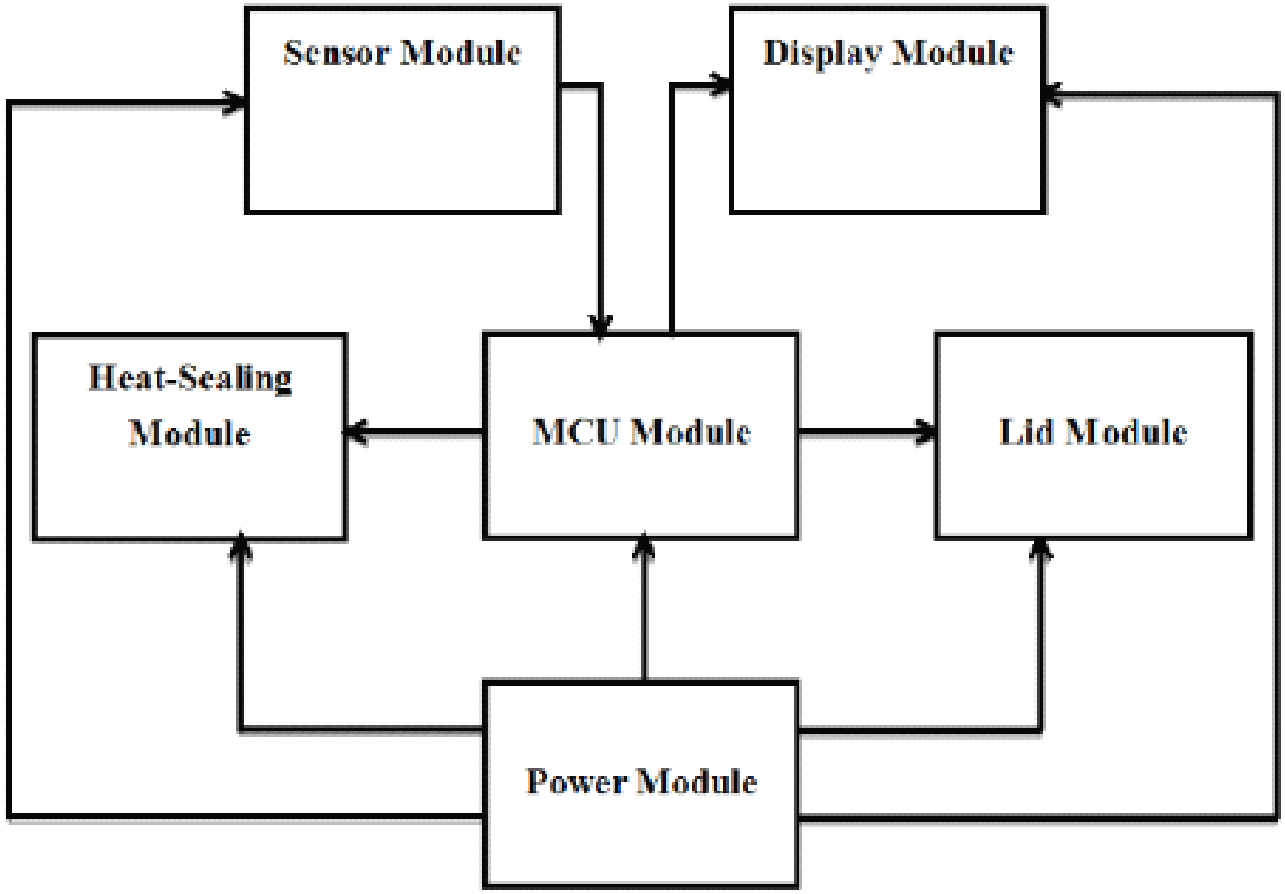
Display Overview







Overall Block diagram



Design Overview

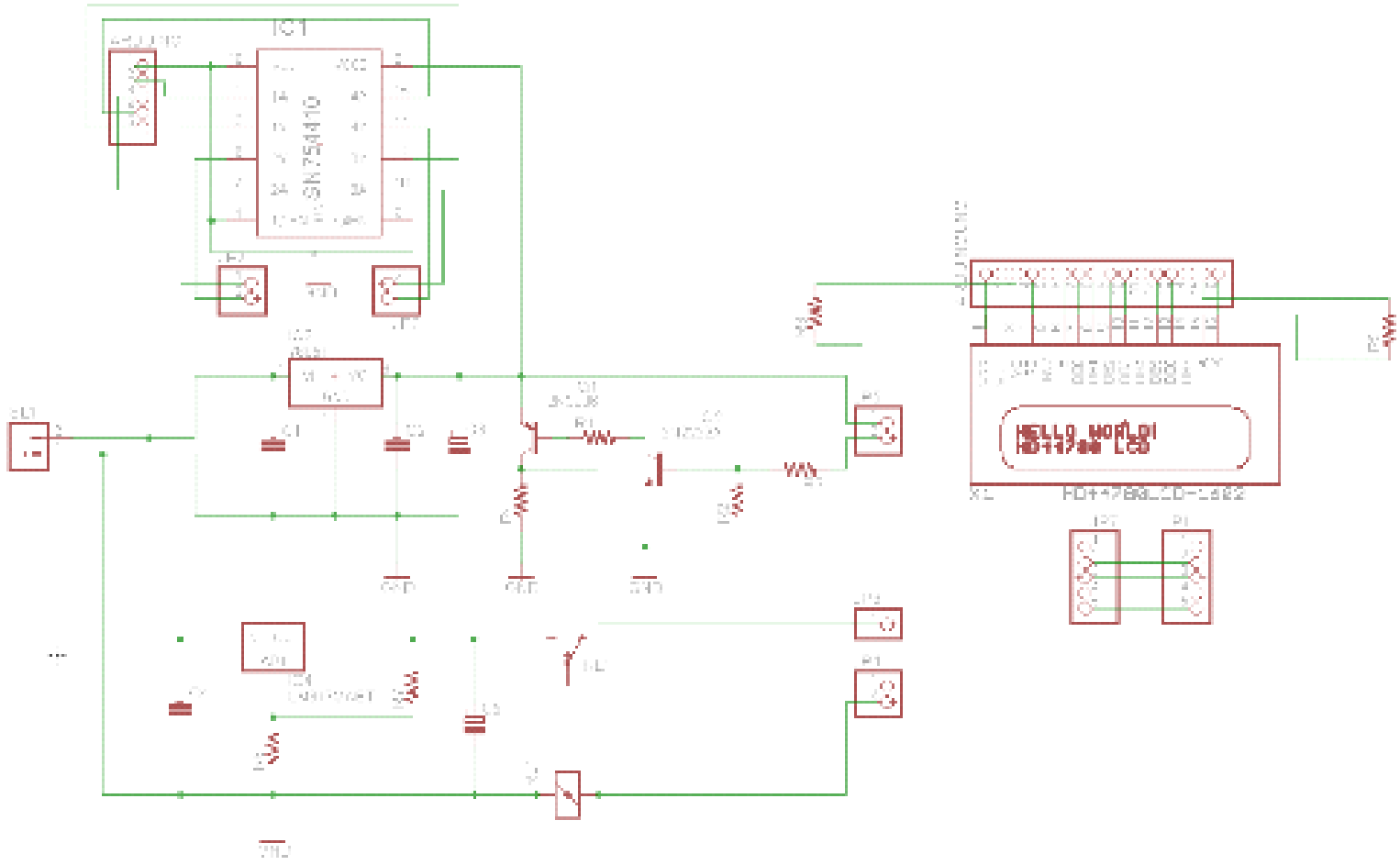
Hardware：

- Lid motor; Heat sealing motor; Motor controller
- Nichrome wire; Relay switch
- Ultrasonice Sensor; Force Sensing Resistor; Water Leak Detector
- AC/DC Power adapter; DC/DC Power Converter
- LCD Screen

Software：

- Arduino UNO

Overall Schematics



Hardware Overview (In House Manufactured)

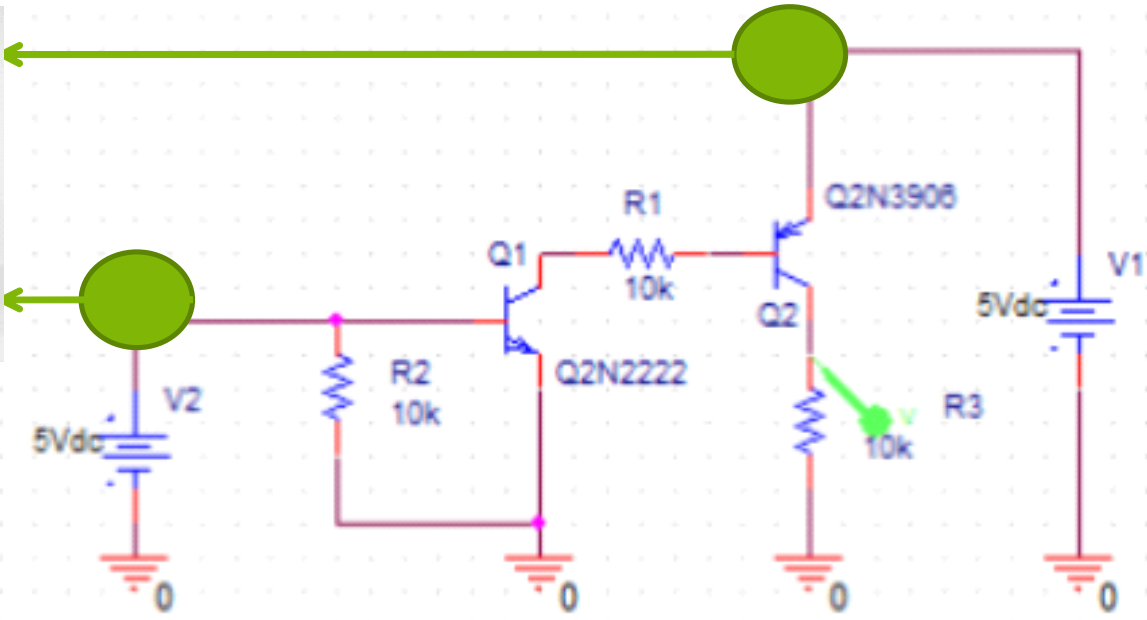
- Water leak detector
  - detects if there is water leakage and passes signals to the microcontroller
- Motors
  - lid motor: open the lid
  - sealing motor: move the nichrome wire to proper position

Hardware Overview (In House Manufactured)

- Heat-sealing
  - Nichrome wire heats up to 130 degree Celsius and melt the bag

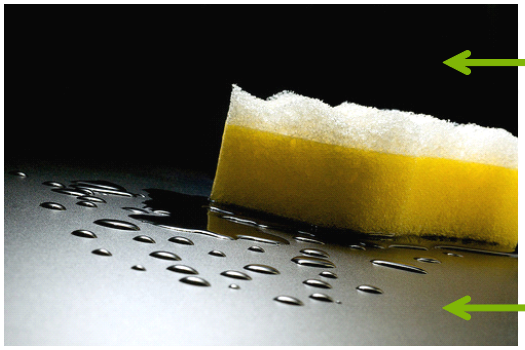
- Power Supply
  - Takes 12V dc from AC/DC power adapter and converts to stable 5Vdc

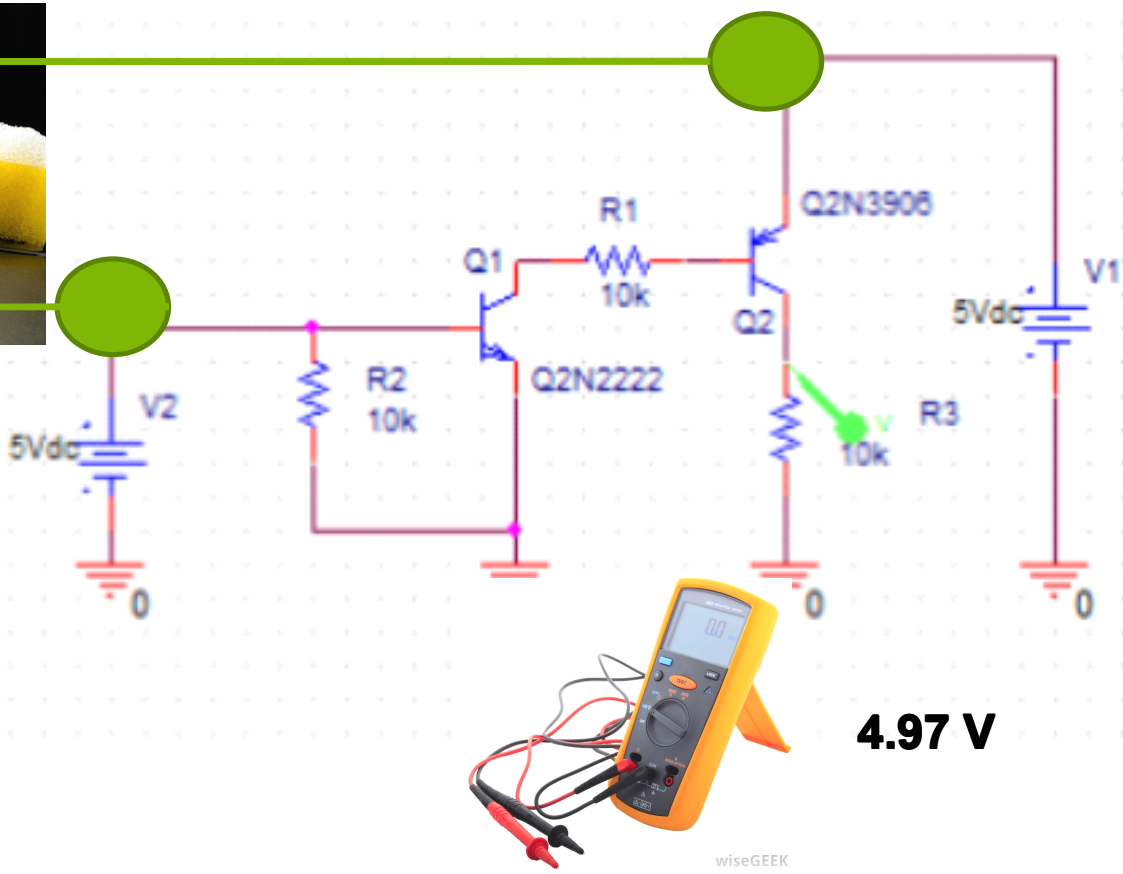
Water Leak Detector (Schematics)



Water Leak Detector (Simulations)

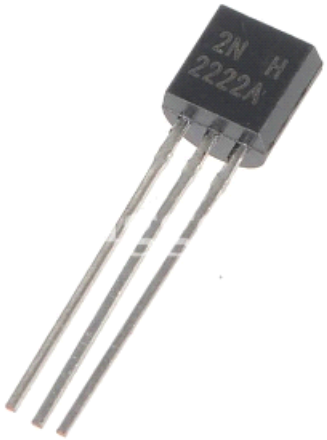
Water Leak Detector (physical test)

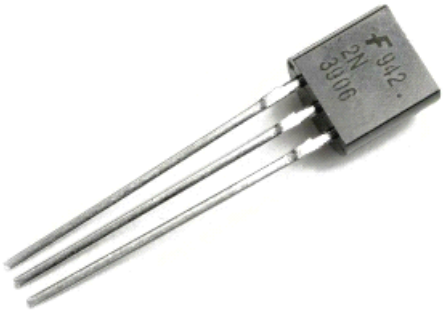




4.97 V

Water Leak Detector (Parts)

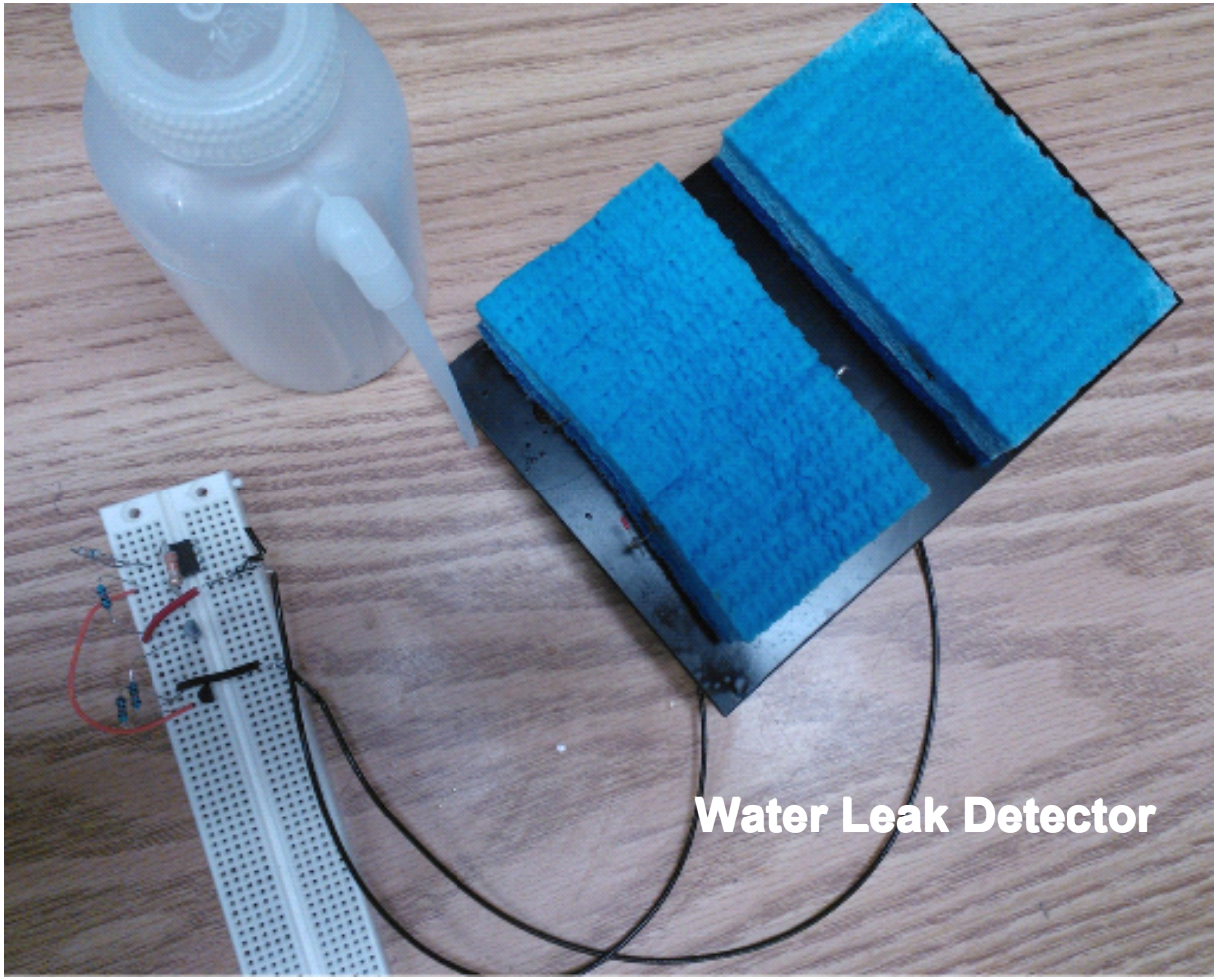




- **Transistor, PNP 2N3906 (1)**
- **Transistor, NPN 2N2222 (1)**
- **Resistors, 10k Ohm, 1/4 watt (3)**
- **Kitchen sponges, pop-up, 3'X4' (2)**

Use a large needle to pierce 2 parallel holes into the side of a sponge, about 2" deep and 1" apart. Strip at least 2" of insulation off 2 pieces of solid copper wire, and insert the bare copper into these holes.

Water Leak Detector

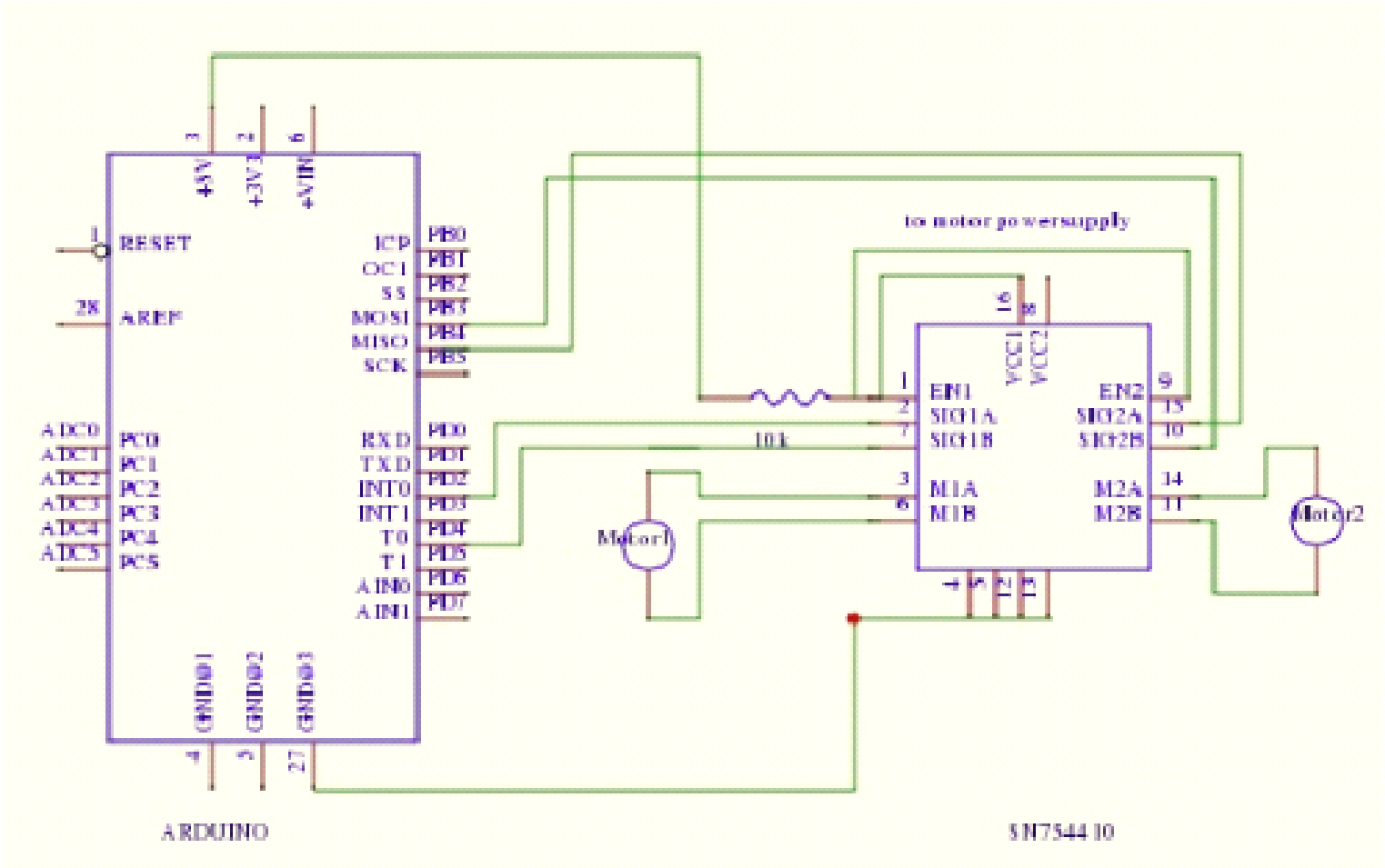


Motor Unit

Motor Pittman GM943

- Pittman GM9434
- 12V dc
- 105 rpm
- High torque
- Motor 1 drives the lid open
- Motor 2 moves the nichrome wire
- Controlled by chip

Motor Control (Schematic)

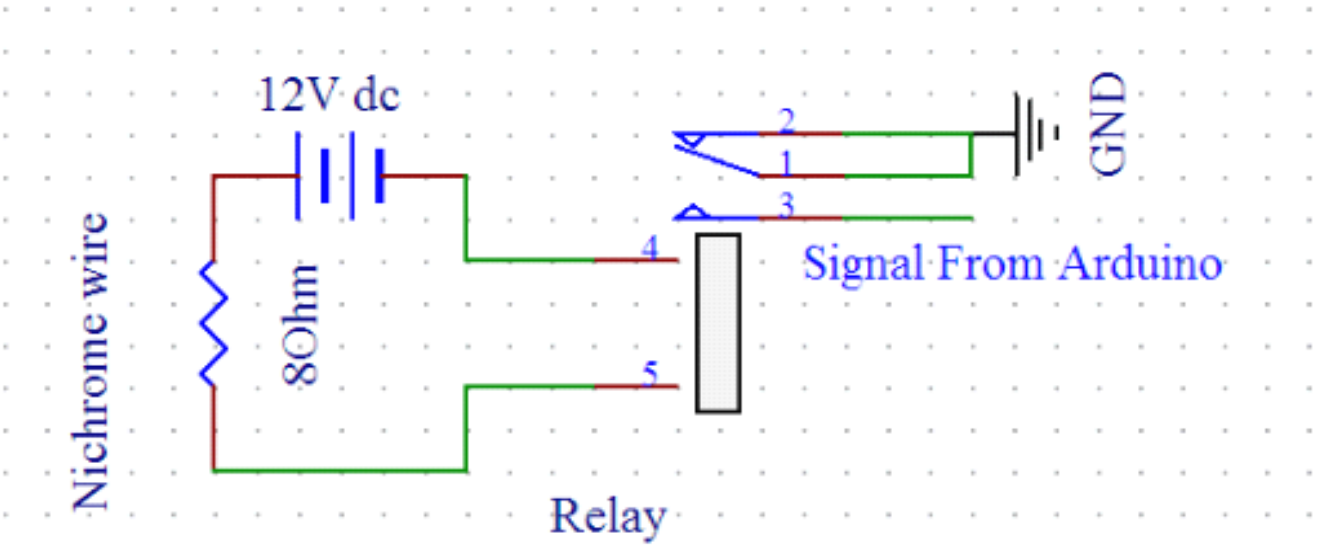


Heat Sealing Unit

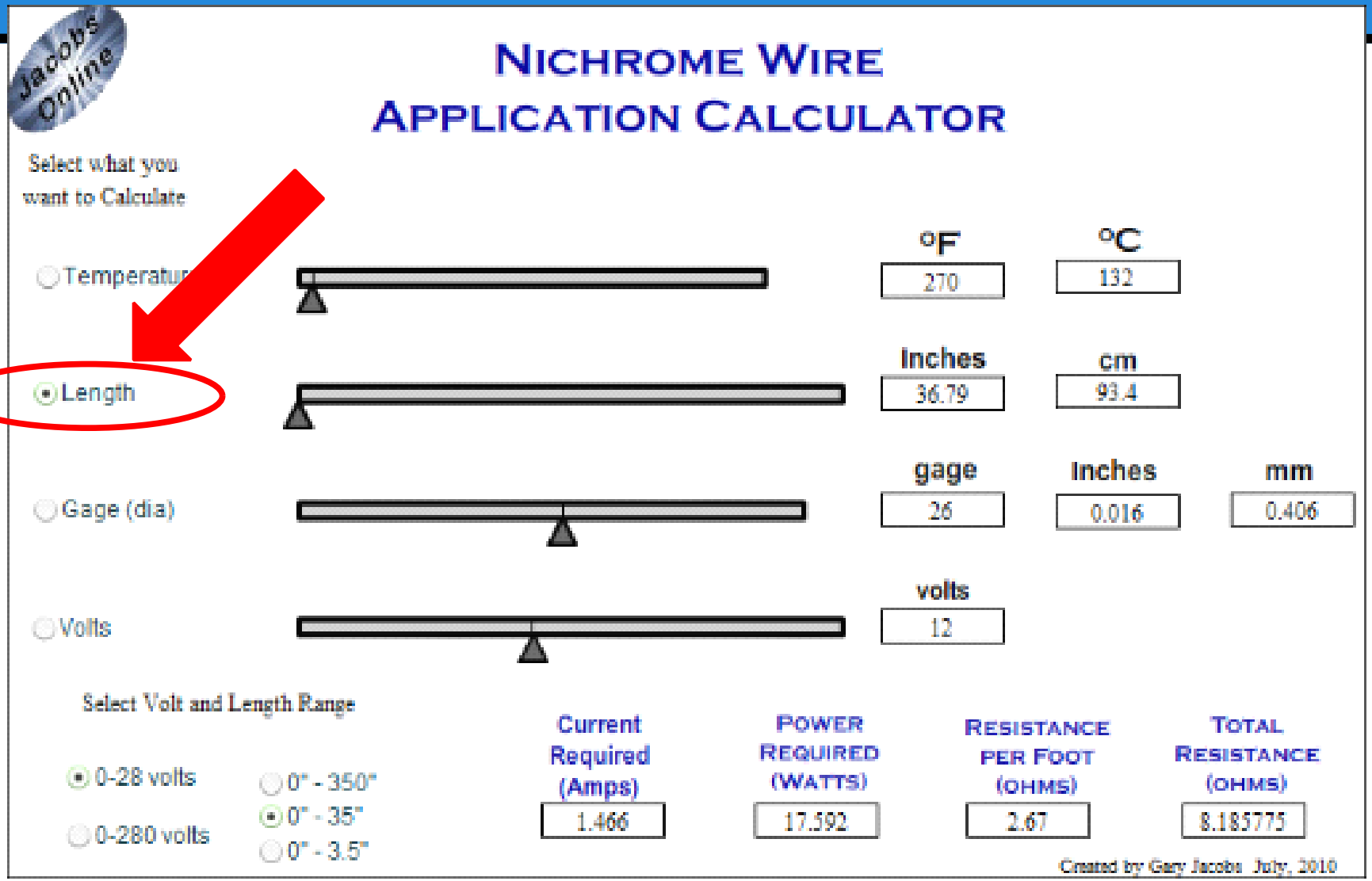

Nichrome wire

- Nichrome wire
- Gauge 26
- 2.67 Ohm/ft
- Heats up to 130 degree Celsius and seal the bag
- Powered by 12V dc
- Relay switching

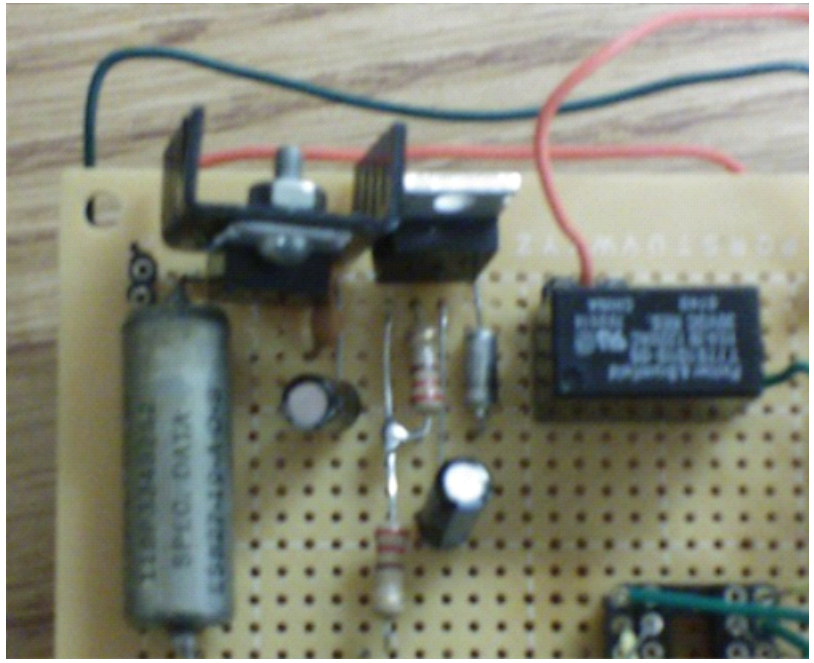
Time control (schematic)



Nichrome wire

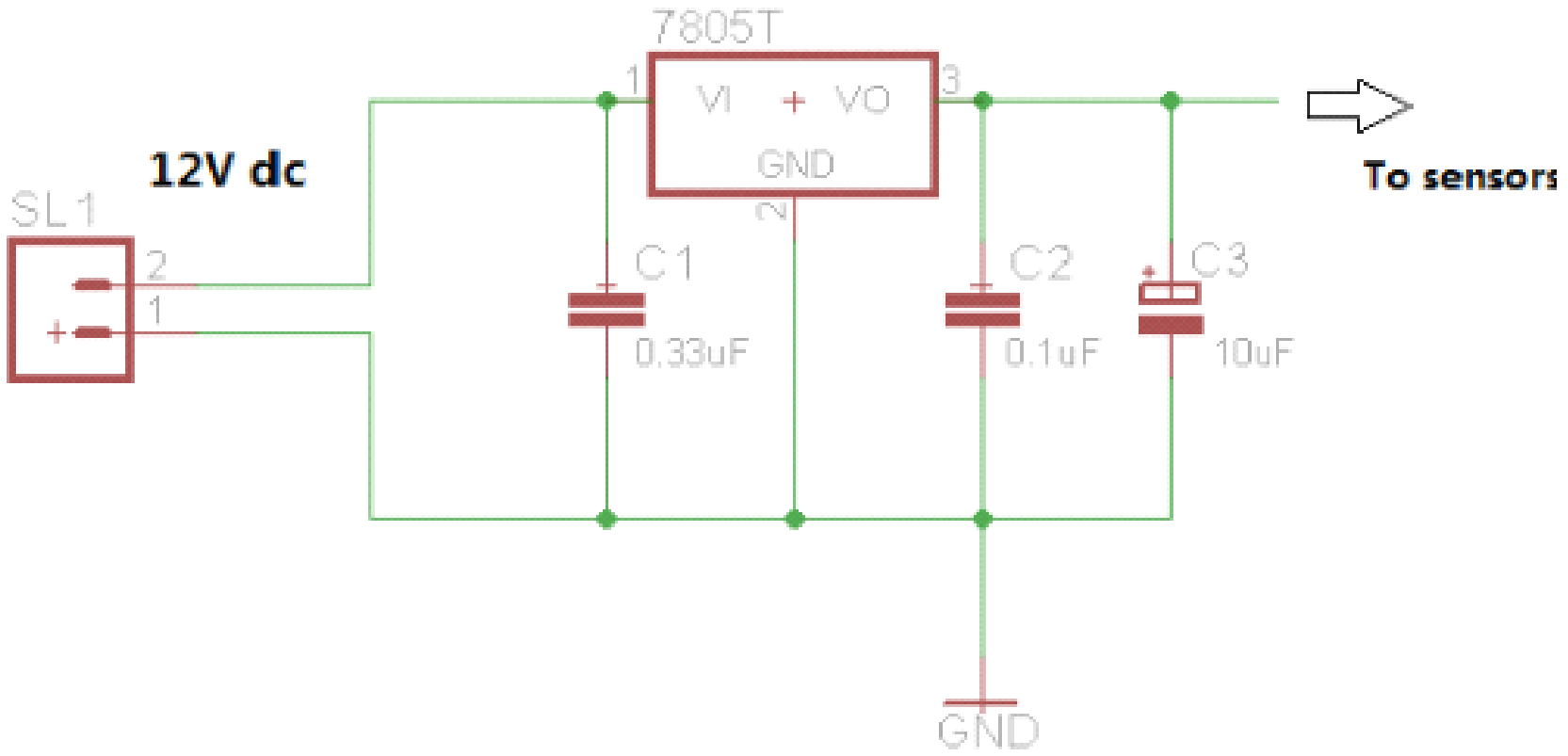


Power Unit



- Supplies +5 Vdc and GND to sensors
- Maximum current: 1.5A
- More current compared to 5V from Arduino

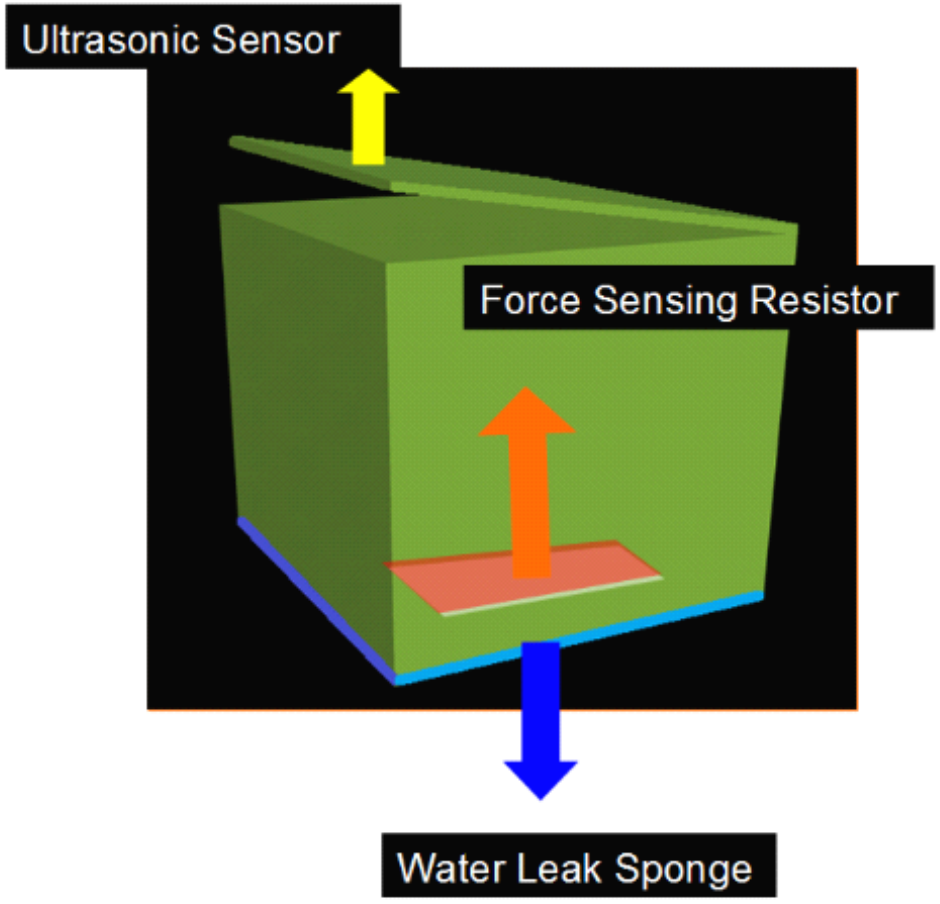
Power supply (Schematic)



Hardware Overview (Outsourced)

- Sensors
  - Ultrasonic Sensor
  - Force sensing resistor: detects the applied force or pressure and transmits signals to the microcontroller
- LCD display
- RTC chip
- AC/DC power adapter

Sensor Unit

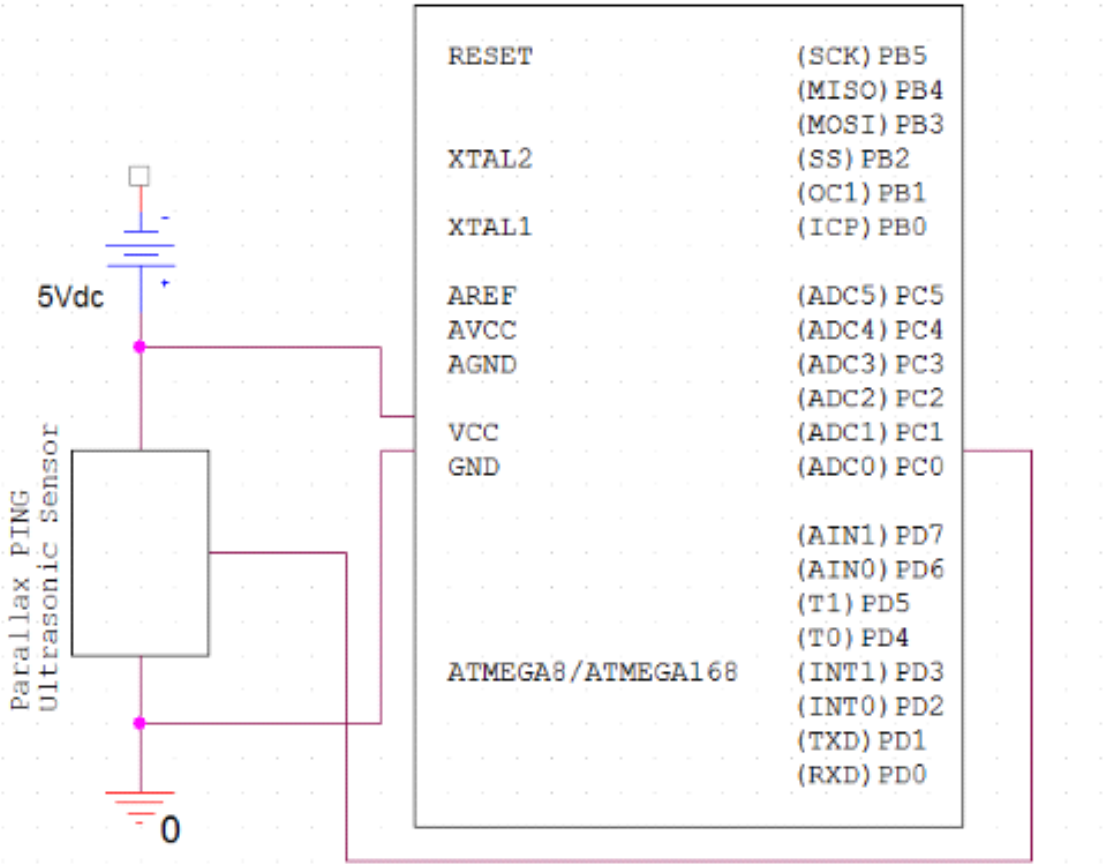


- Ultrasonic Sensor
- Force Sensing Resistor
- Water leak detector

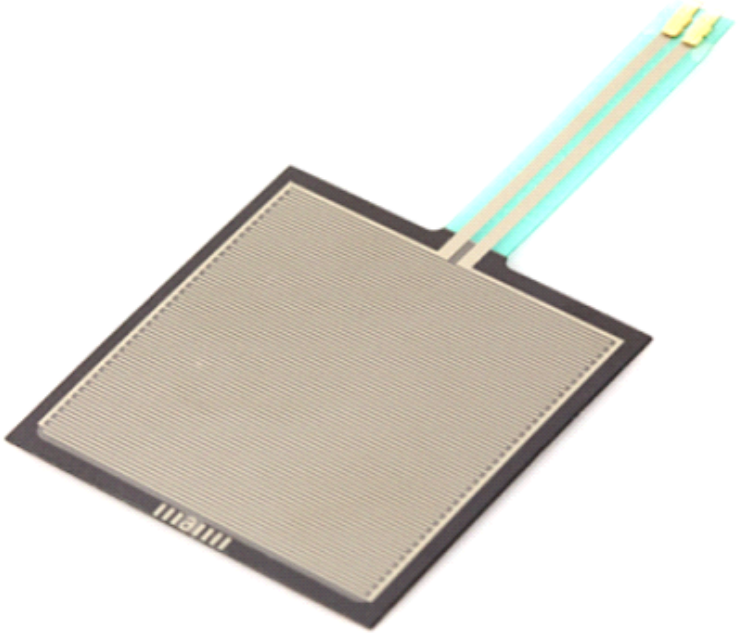
Ultrasonic Sensor

- Parallax PING Ultrasonic Sensor
- Provides precise, non-contact distance measurements within a 2 cm to 3 m range
- Simple pulse in/pulse out communication
- Burst indicator LED shows measurement in progress
- 20 mA power consumption
- Narrow acceptance angle
- 3-pin header

Ultrasonic Sensor (Schematic)

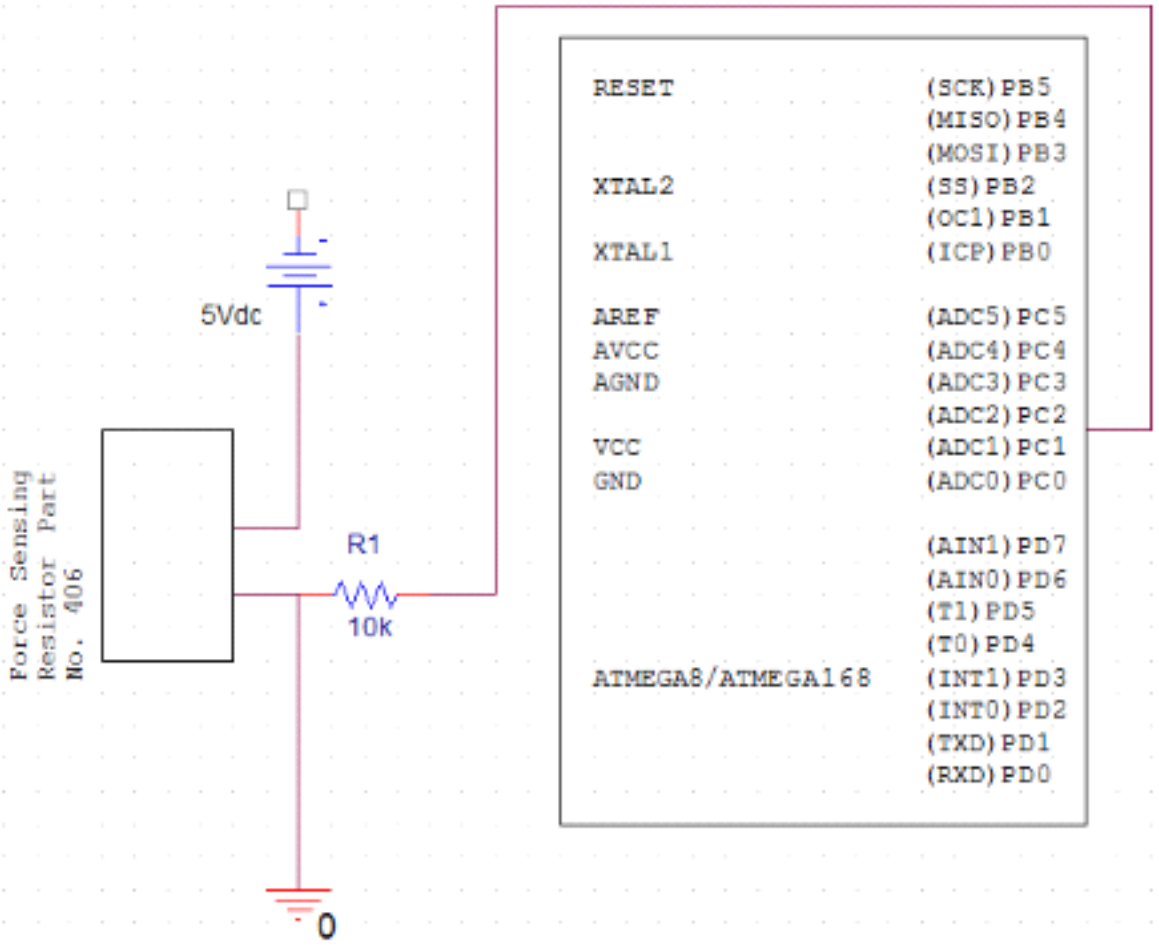


Force Sensing Resistor



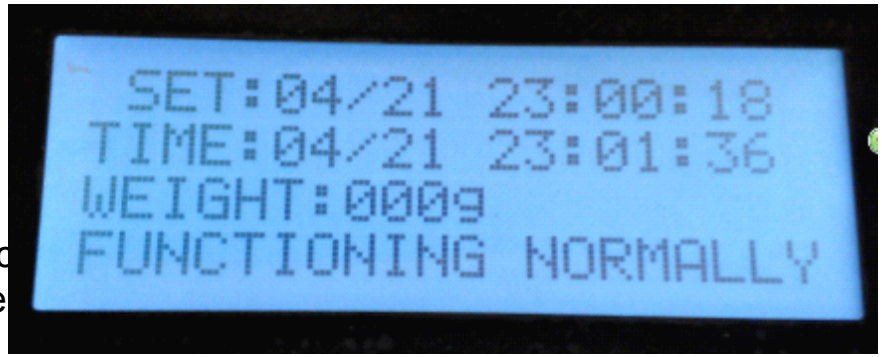
- Force Sensitive Resistor-square
- a square, 1.75x1.5", sensing area.
- consist of a conductive polymer
- FSR can sense applied force anywhere in the range of 100 g-10 kg
- Two pins extend from the bottom of the sensor with 0.1" pitch

Force Sensing Resistor (Schematics)

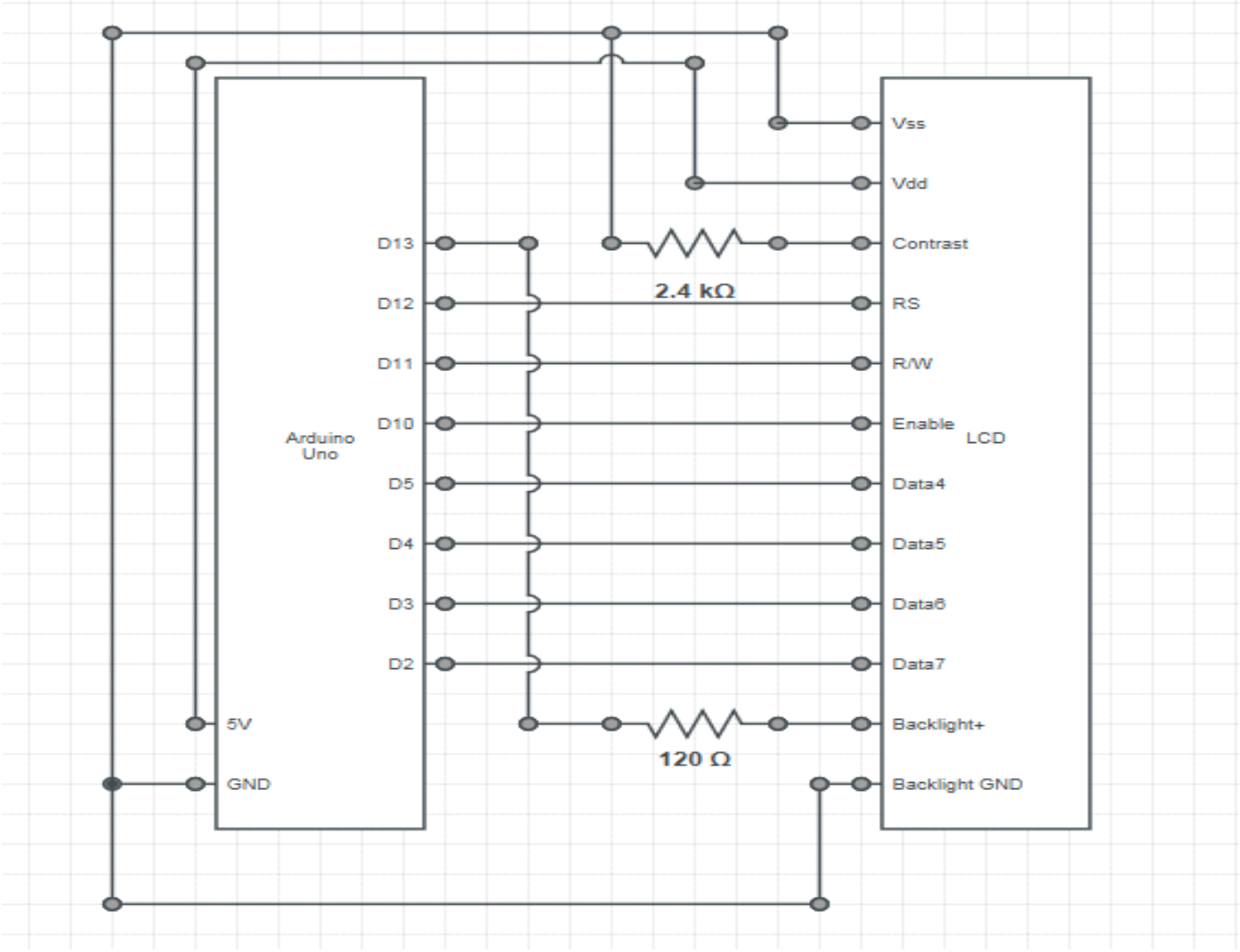


LCD Screen

4X20 LCD screen
Black character on blue sc
Based on HD44780 mode
98 x 60 mm



LCD Pin Layout



3 different display of LCD

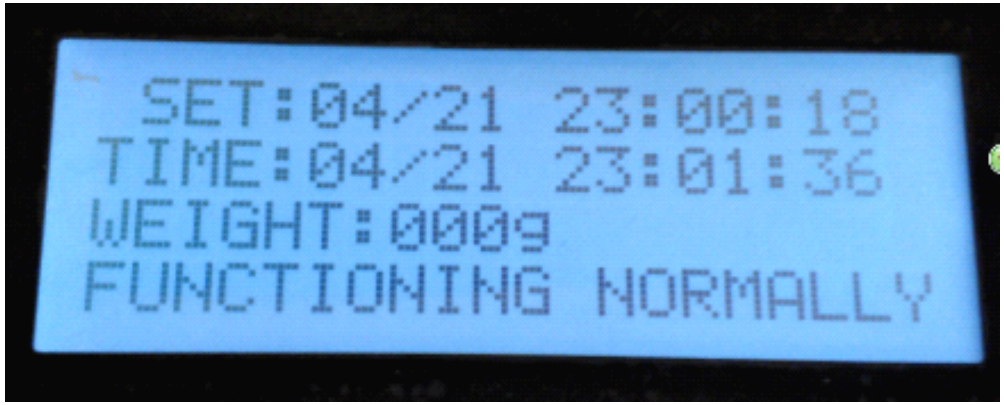
Normal Operation

The time this current bag is set

The current time

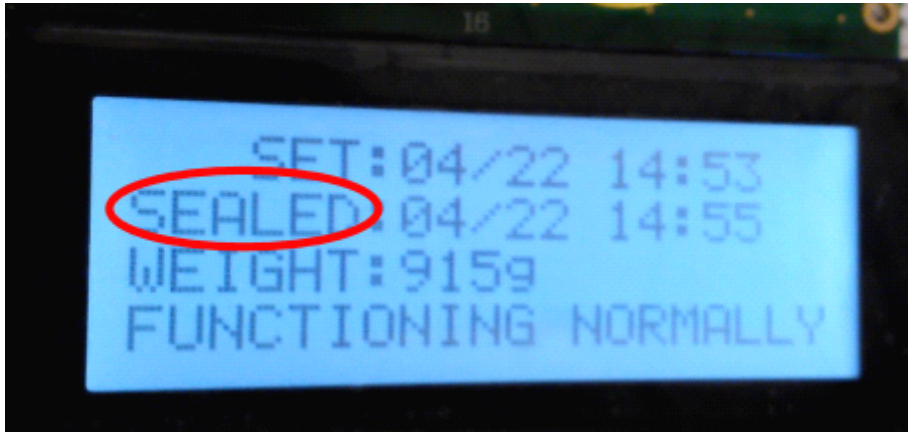
The current weight of the bag

“FUNCTIONING NORMALLY”



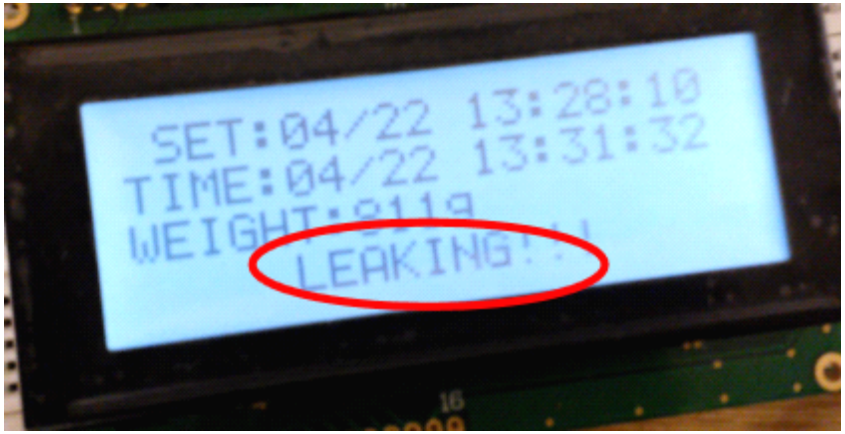
3 different display of LCD

When the bag is sealed:
The time this current bag is set
The time this bag is sealed
The sealed weight of the bag
“FUNCTIONING NORMALLY”



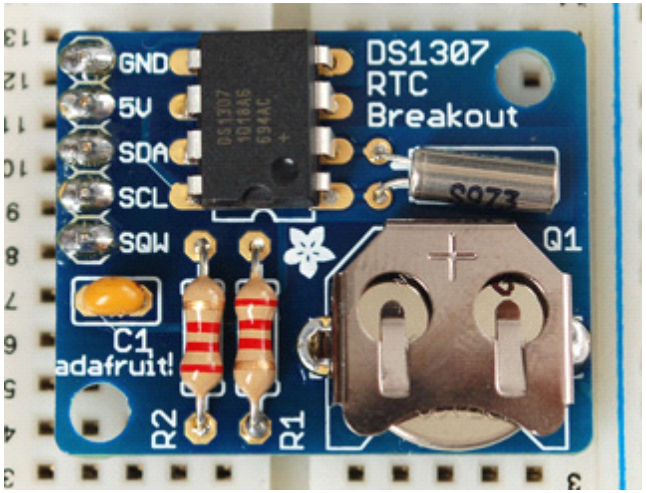
3 different display of LCD

When There is a leak:
The time this current bag is set
The current time
The current weight of the bag
“LEAKING!!!”

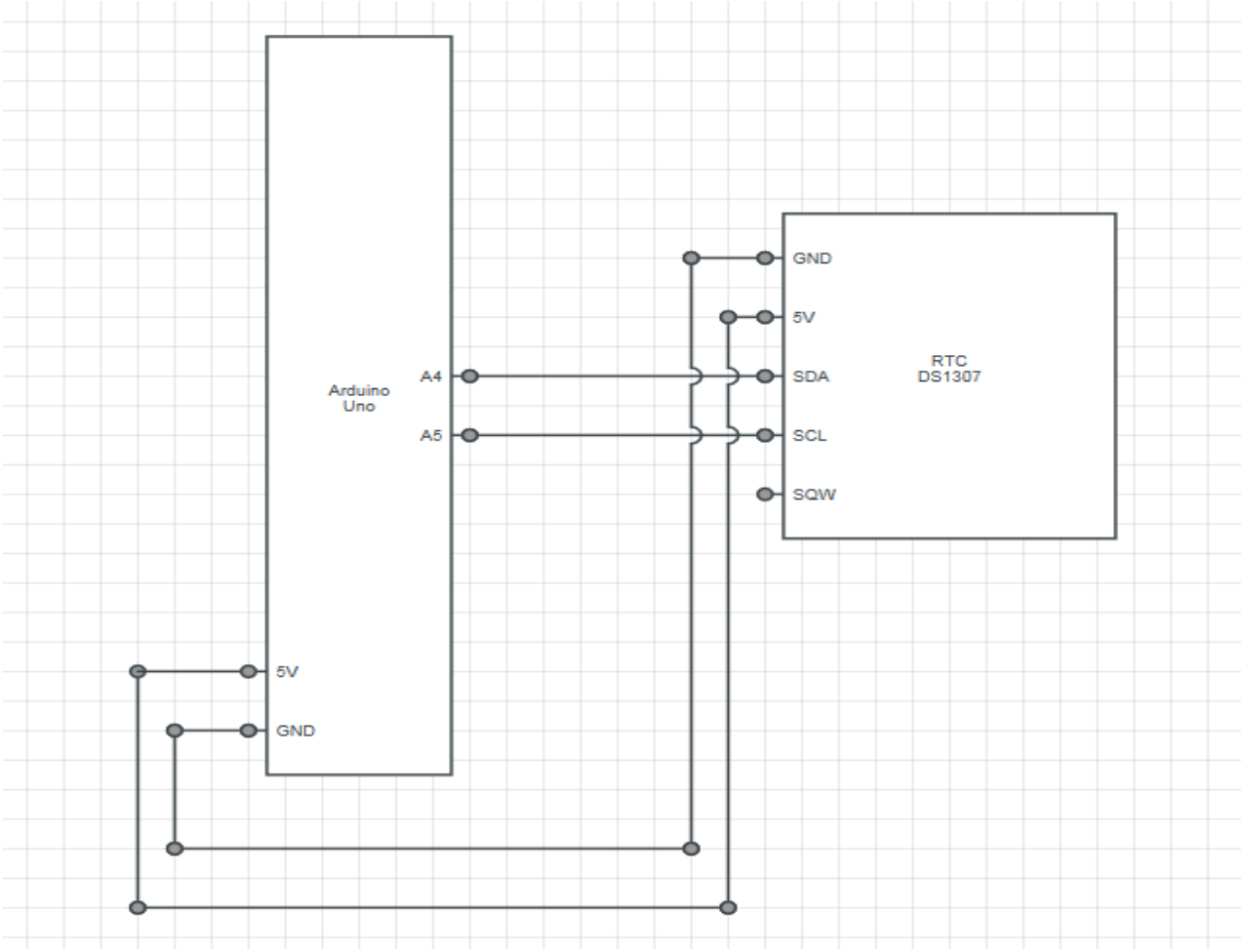


RTC chip

Real Time Clock Chip: DS1307
Capable of tracking time even if power is lost
5V input, 24mm x 30mm, 4g



RTC Chip Pin Layout

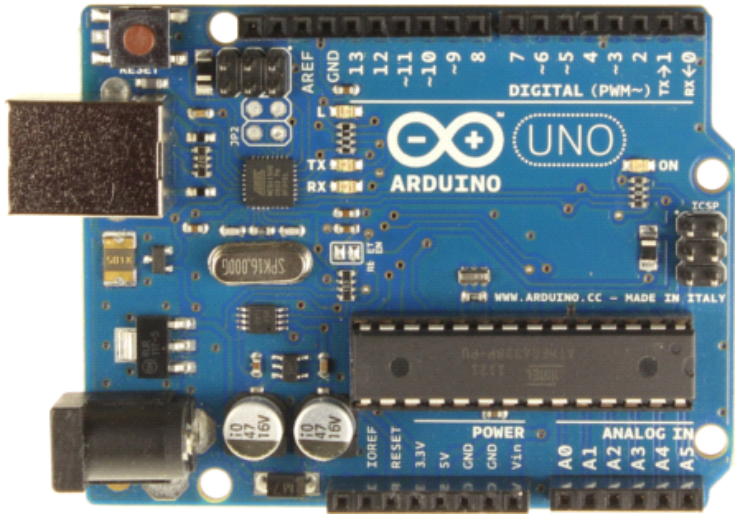


AC/DC adapter

- Input: Wall outlet
- Output: 12V 5A 60W Max
- power is supplied to
    - Nichrome wire (max 1.5A)
    - Motor (max 1A)
    - Arduino

Software Overview

We are using Arduino Uno chip as Micro- controller



Advantage

Small size and light weighted

Pins can be both input and output

Digital and analog pins are interchangeable

MCU Layout

Analog Input/ Output

A0: Force sensor

A1: Ultrasonic sensor

A2: Heating wire controller

A3: Leak detection sensor

A4: RTC SDA

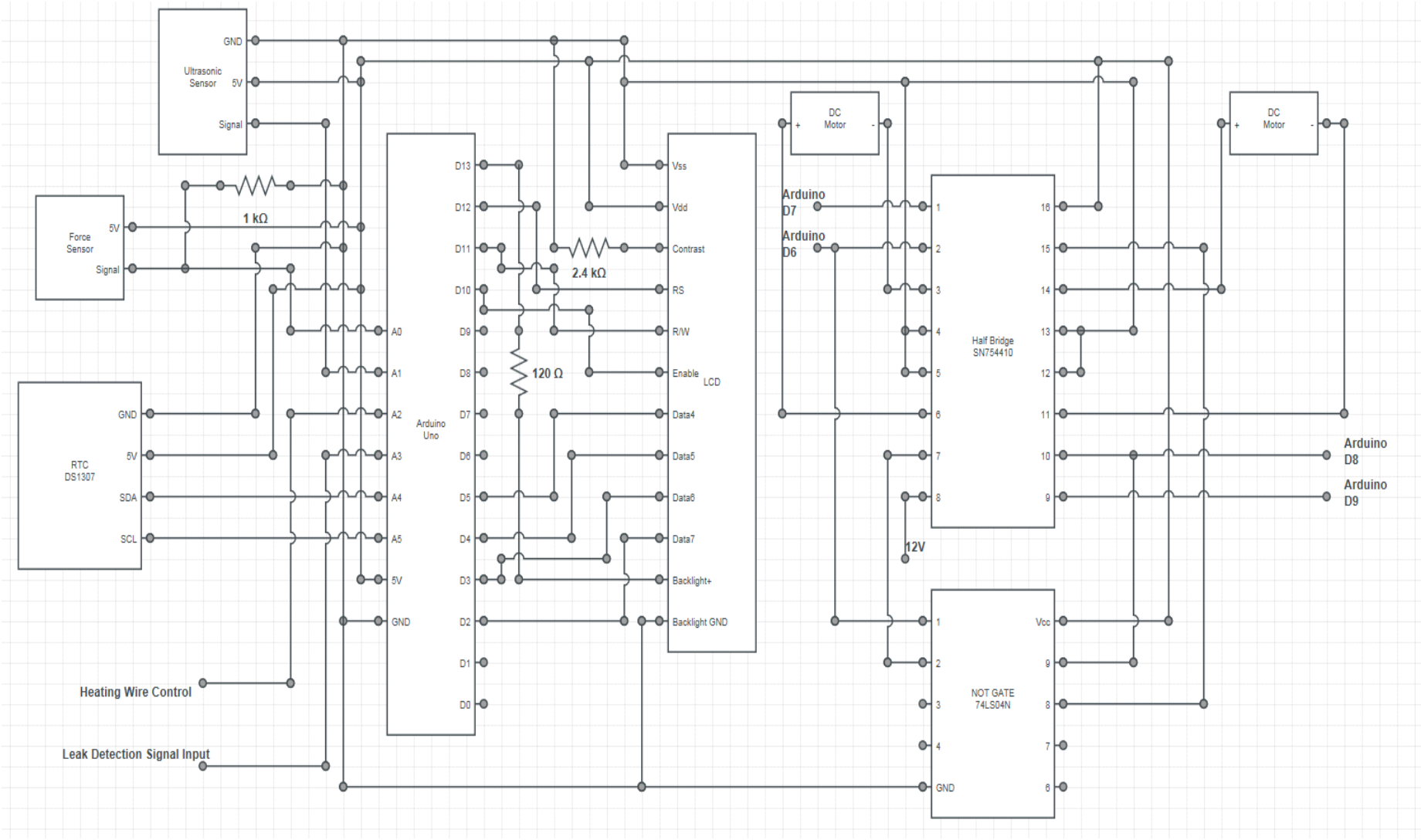
A5: RTC SCL

MCU Layout

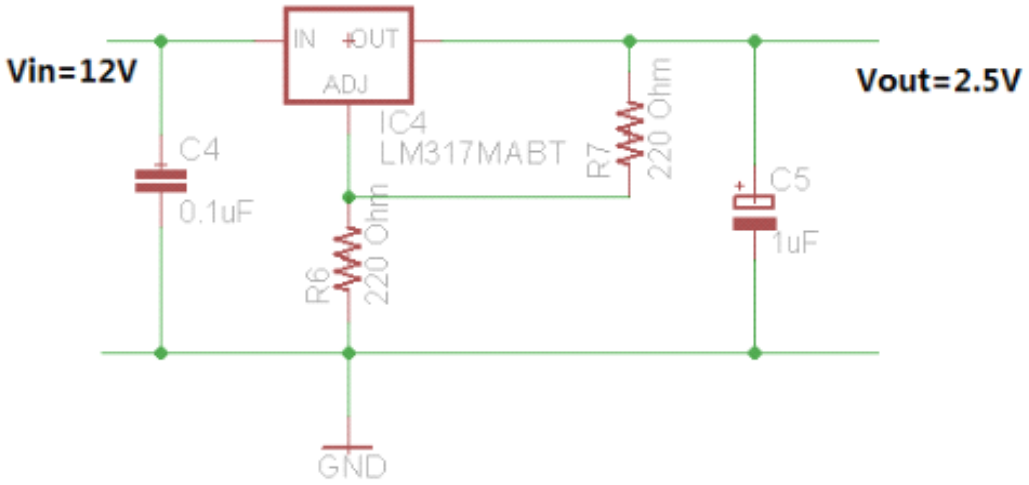
Digital Input/ Output

D2: LCD Data pin 7
D3: LCD Data pin 6
D4: LCD Data pin 5
D5: LCD Data pin 4
D6: Lid Motor Direction Control
D7: Lid Motor Speed Control
D8: Sealing Motor Direction Control
D9: Sealing Motor Speed Control
D10: LCD R/W
D11: LCD RS
D12: LCD contrast
D13: LCD Backlight

MCU Pin Layout Overview



Failed Verification

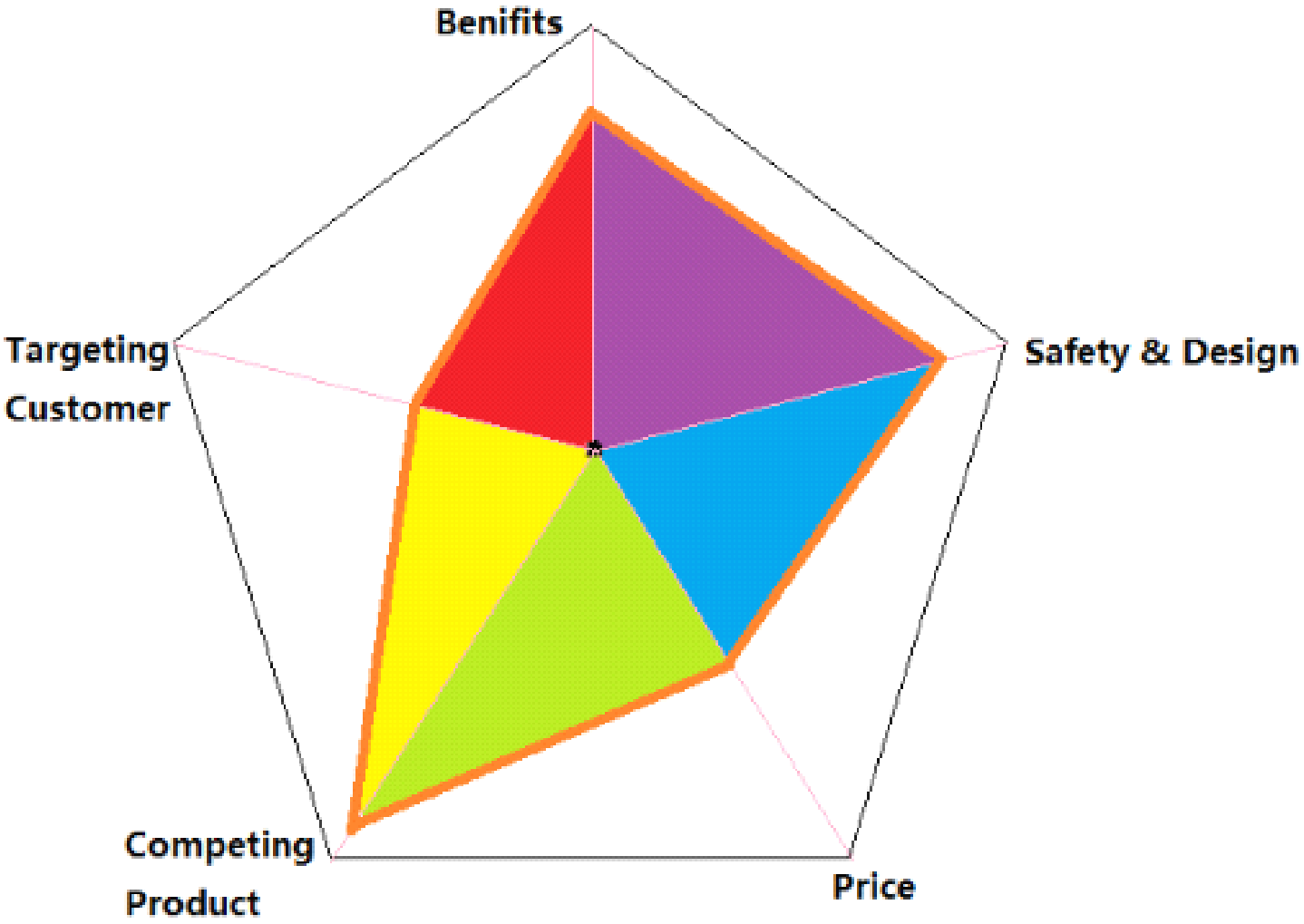


? 2.5V keeps dropping down while connected to the nichrome wire

! Resistance of nichrome wire is too small;

Had to use 12V DC and increase resistance

Conclusion & Analysis of Product



Ethical Issues

1. to accept responsibility in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;

5. to improve the understanding of technology; its appropriate application, and potential consequences;

7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;

Future Development

- Hardware
  - motor with less weight
  - with different gauge of nichrome wire, it can be wrapped around the rod with no space between coils
  - Larger trash can
  - water leak detector
    - needs accurate measurement on the threshold of the amount of water that triggers detection
    - needs more precise allocation on the spot of leakage

Credits

Dennis Yuan
Prof. P. Scott Carney
Mr. Scott McDonald's
Mr. Dan Mast

Thank you!

Thank you for your time!

Any Questions?