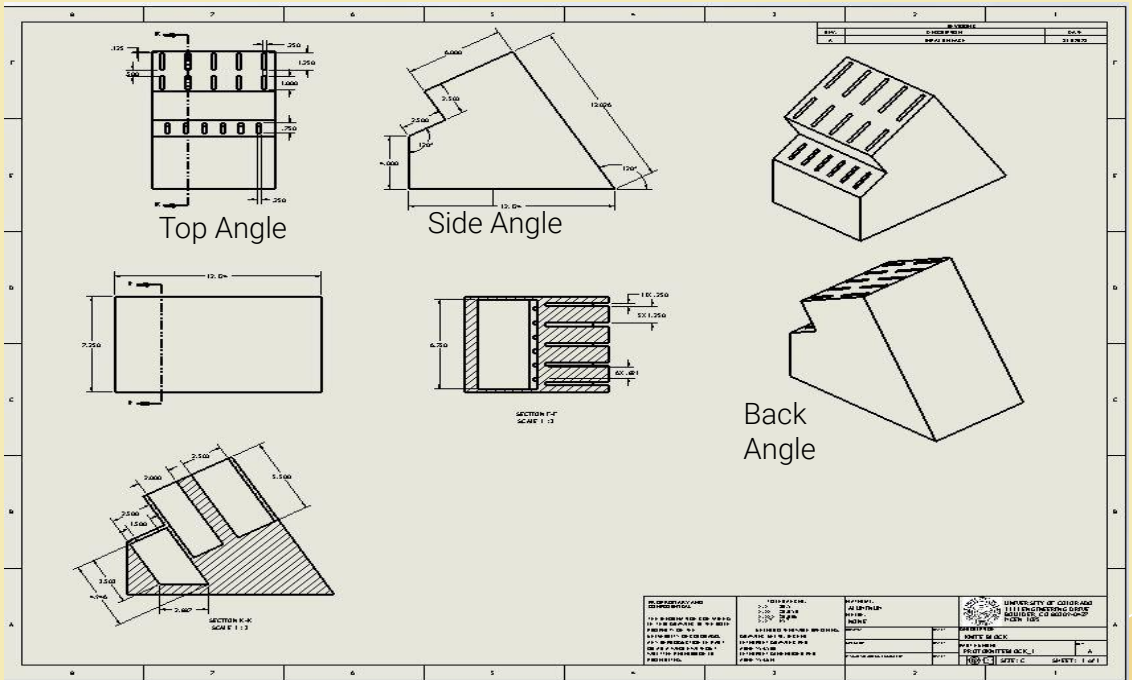
Critical Design Review

Team ButterFlies

Review

Our Plan : Create a knife block that heats up water in a compartment in order to heat utensils which would then be able to cut through butter. This product is designed for those interested in new kitchen gadgets



***Initial CAD**

Failures

1. *Circuit: Have to use AC and DC in heating system*

2. *Knife block: The scale of the drawer is not big enough to store heating elements*

3. *Hygiene: drawer for heating element should be hygienic and efficient. Aluminum or Steel?*

Iterations

1. Make heating drawer a Stainless steel drawer
2. Change the height of our knife block to fit all the heating elements
3. Make drawer bigger to fit heating elements

Engineering Analysis

- ***Based on our failures we were able to solve all problems except circuit issue***
- ***So we decide to meet with ITLL engineer***

Solution: *isolate the control circuit and the Arduino to separate DC power sources then add a resistor and a diode to stop the current from oscillating*

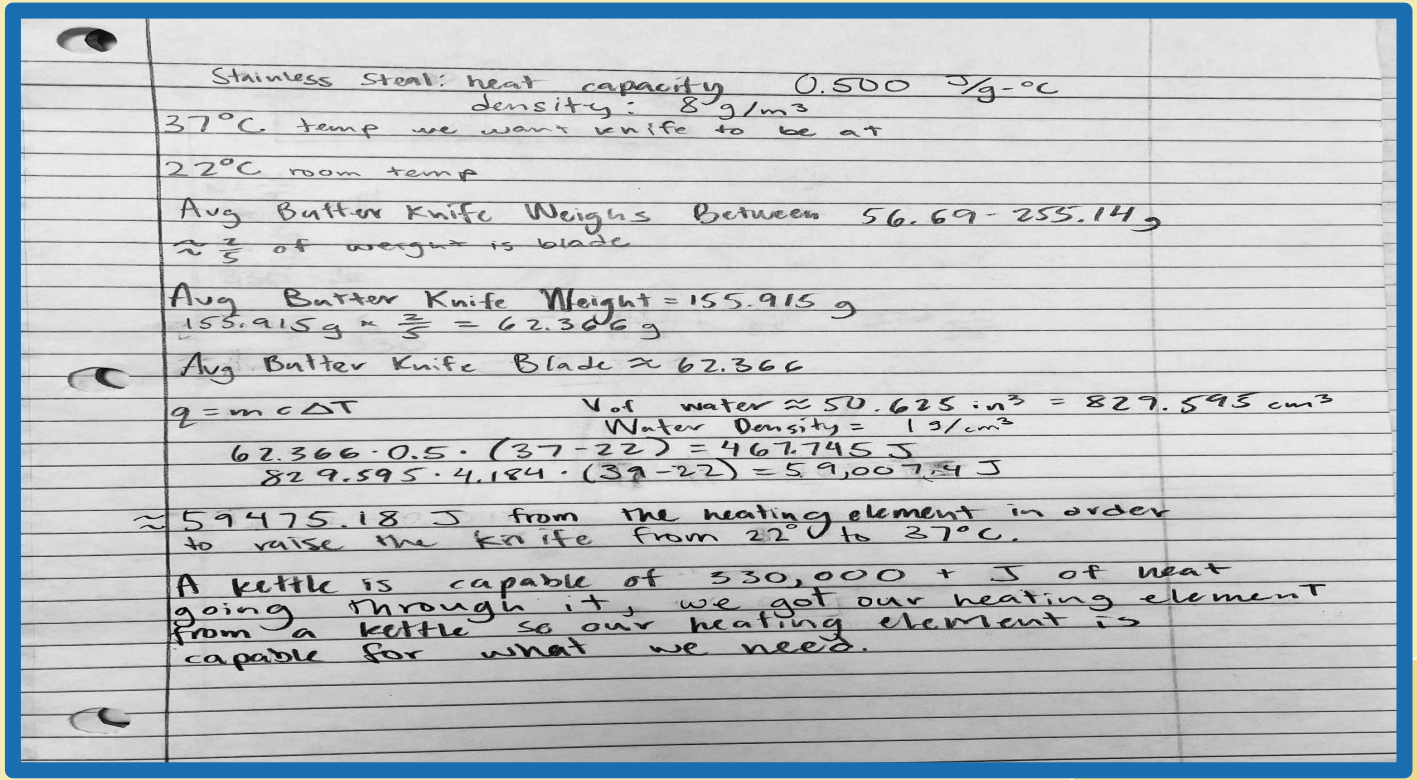
Engineering Analysis pt.2

- *To test the product: Test part by part*

1. *Test if heating system fits in block*
2. ***Heat water until it reaches 98.6℉ or 37℃***
3. *If failed iterate until fit for our project*

Engineering Analysis pt.3

❑ Calculations



Stainless Steal: heat capacity 0.500 J/g-°C
density: 8 g/m³
37°C temp we want knife to be at
22°C room temp
Avg Butter Knife Weighs Between 56.69 - 255.14 g
≈ 2/5 of weight is blade

Avg Butter Knife Weight = 155.915 g
155.915 g × 2/5 = 62.366 g
Avg Butter Knife Blade ≈ 62.366

$q = mc\Delta T$

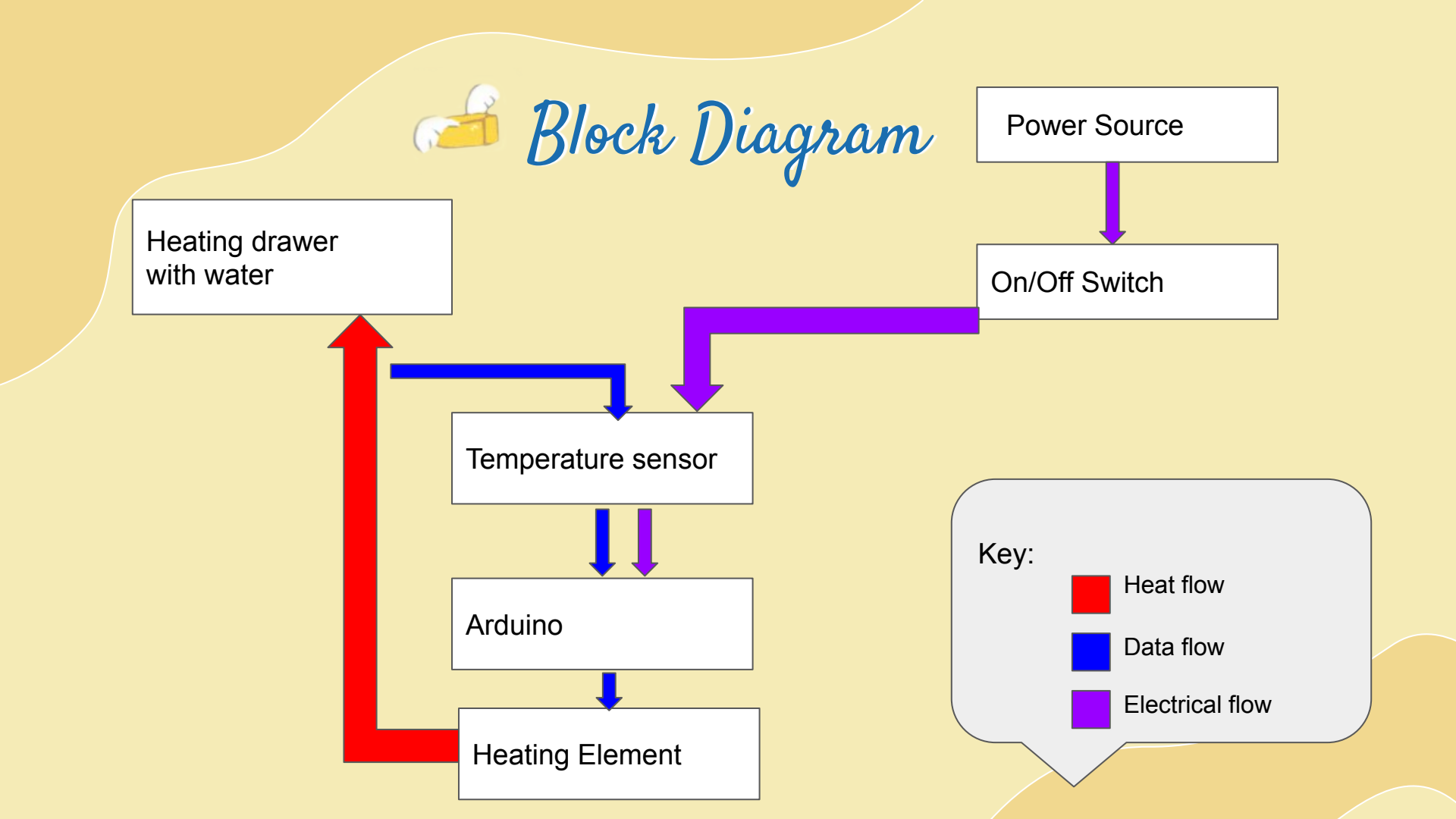
Vol of water ≈ 50.625 in³ = 829.595 cm³
Water Density = 1 g/cm³

$62.366 \cdot 0.5 \cdot (37 - 22) = 467.745$ J
$829.595 \cdot 4.184 \cdot (37 - 22) = 59,007.4$ J

≈ 59475.18 J from the heating element in order to raise the knife from 22° to 37°C.

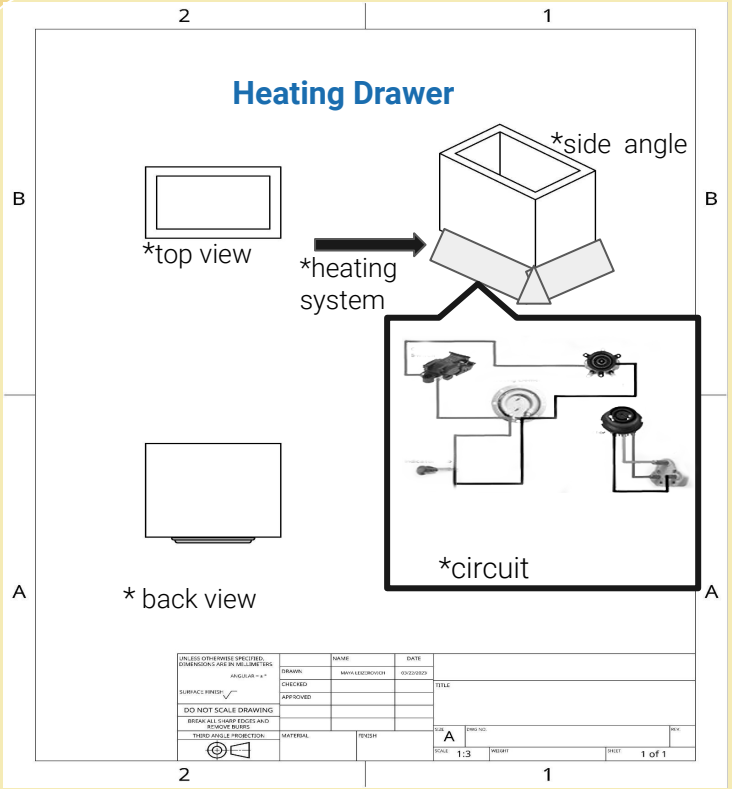
A kettle is capable of 530,000 + J of heat going through it, we got our heating element from a kettle so our heating element is capable for what we need.

Block Diagram

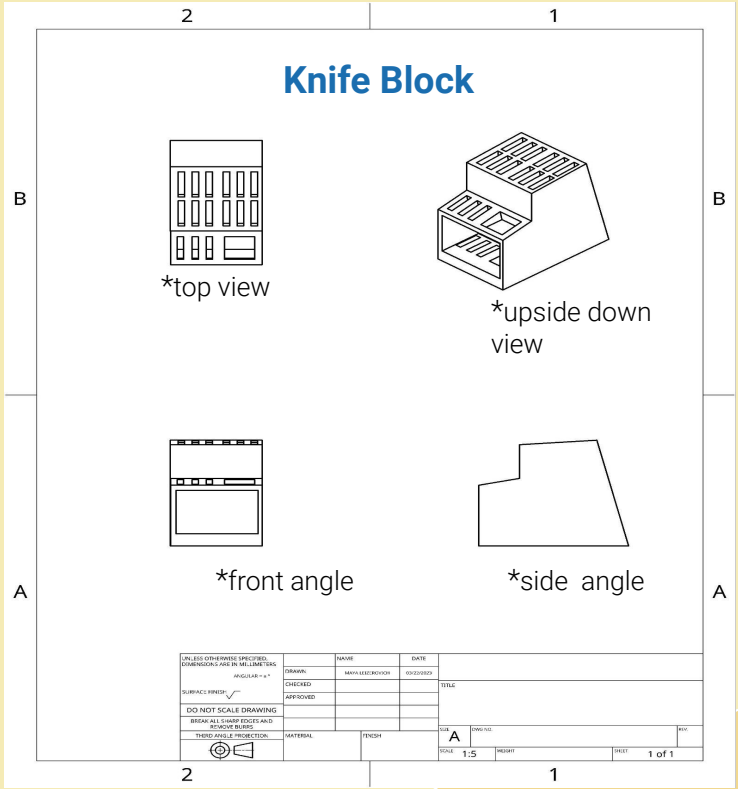


Current Model

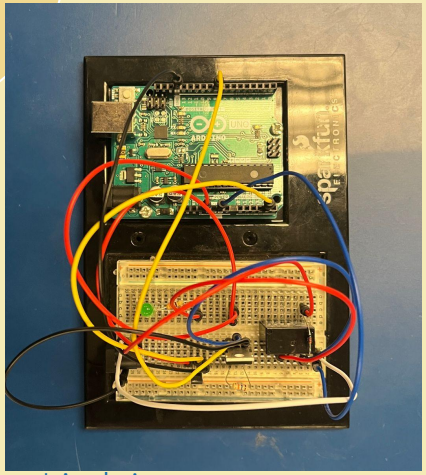
Heating Drawer



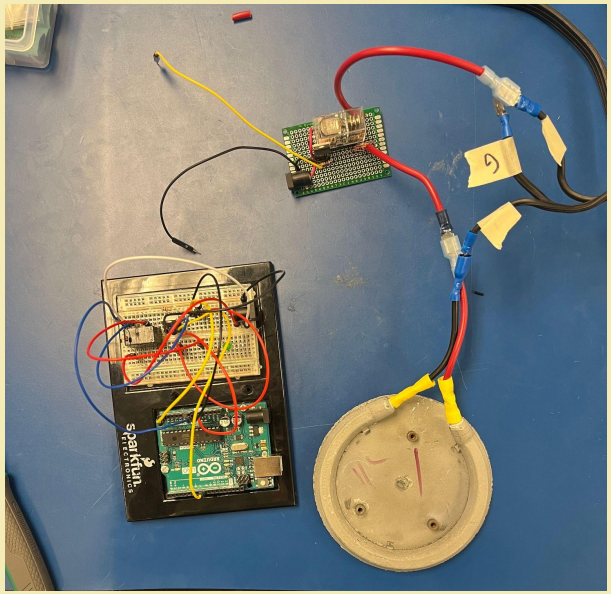
Knife Block



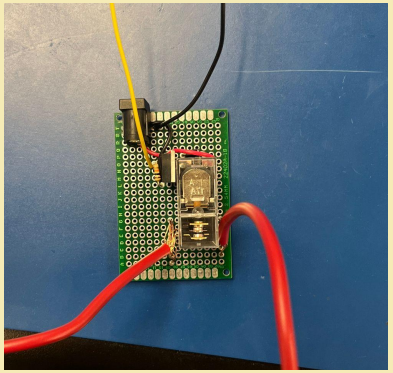
Critical Parts for Heating Element



*Arduino



*Overall System



*Switch control

Material Cost

- Wood *54$
- Stainless steel 68$
- On/ off switch *free
- Wires *free
- Relay *free
- Diode *free
- Temperature sensor *free
- Resistors *free
- Kettle heating element *free
- Nails *5$
- Wood Glue *7$

Total: 134$

Current Timeline