Cool Hand Lab

by rabbitcreek on March 27, 2016

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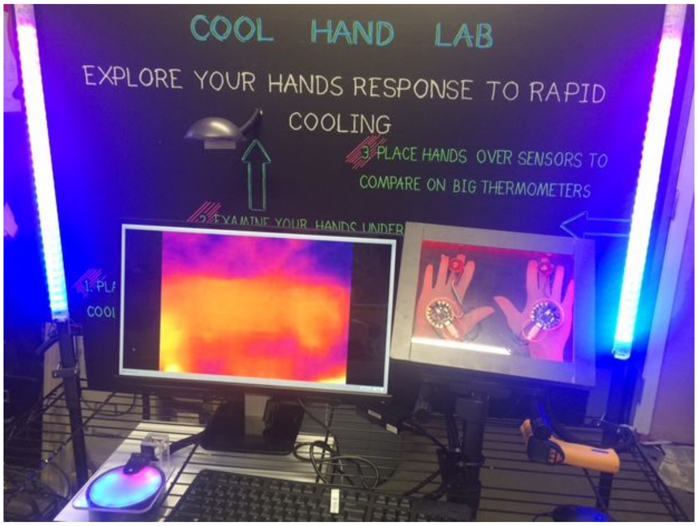
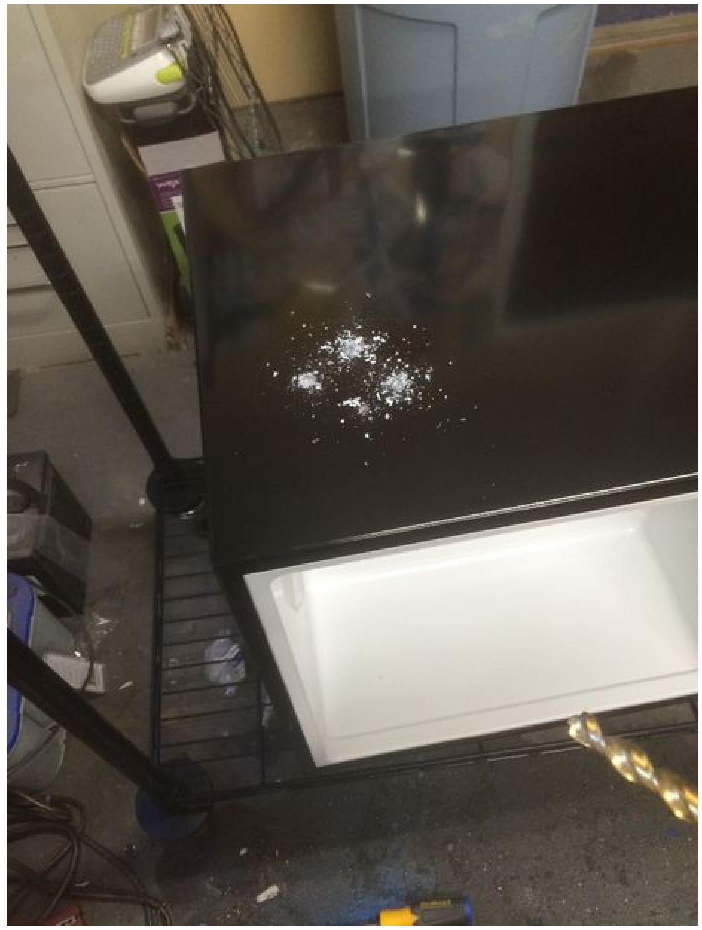
Intro: Cool Hand Lab

How do people respond to the cold? Here in Alaska people have been studying the adaptations to cold climates that humans have mastered in the last 50,000 years. Back in the 1950's scientists began to measure the effects of cold temperatures on the extremities and an individuals response to it. This involved placing needle thermocouples in skin and muscle and even deeper body cavities. Volunteers would place their hands in amazingly cold water for a very long time to find out what happened. This exhibit done for the **Anchorage Museum at Rasmuson Center** will allow people to participate in this type of research and study their own response to a quick hand chilling.



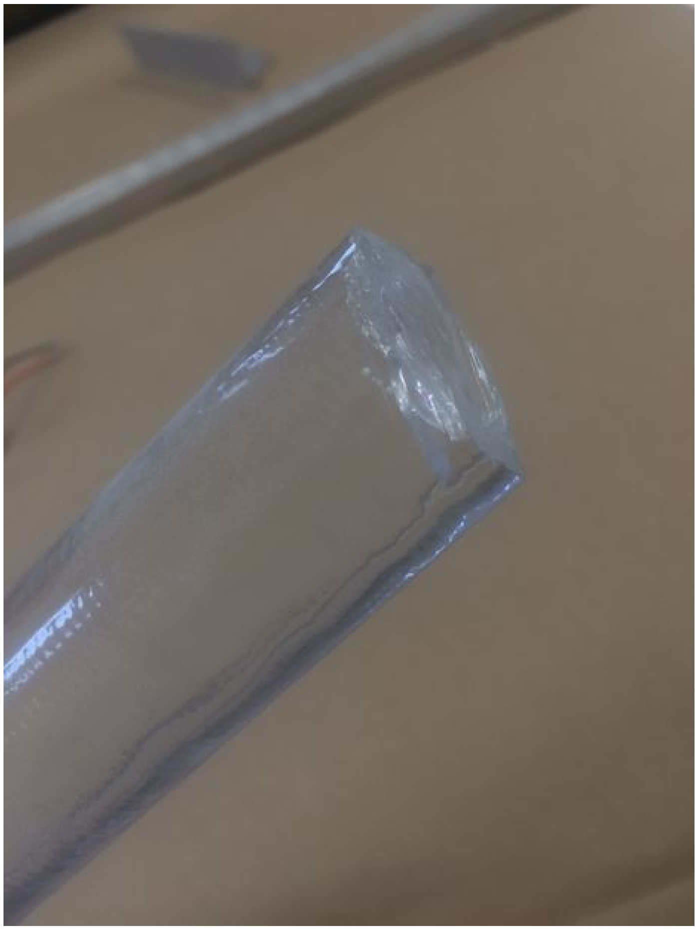
Step 1: Cooling chamber

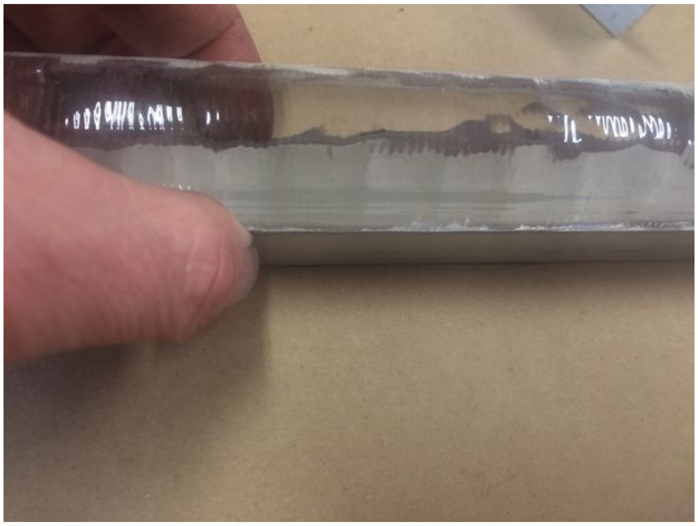
We built the cooling chamber out of a dorm refrigerator. Careful which brand you choose--Emerson brand from Target places the cooling coils in the left wall leaving you free to make a big gaping hole with a saw in the roof. The picture in the middle is after I just cut through the coils in another manufactures machine and ruined it...(can't bill the museum for that one...) A variety of cooling gloves were tried--rubber lined, but were found to be too insulating. In the end a large clear dry bag filled with a combination of water and Soil Moist granules was attached by hose clamps to the upper PVC housing in photo. Into this was inserted a small waterproof nylon sock which was sealed internally to the rim. While keeping the hand dry, the flexible bags proximity to the solution allows rapid cooling. A ring of NeoPixels around the opening completes the effect.

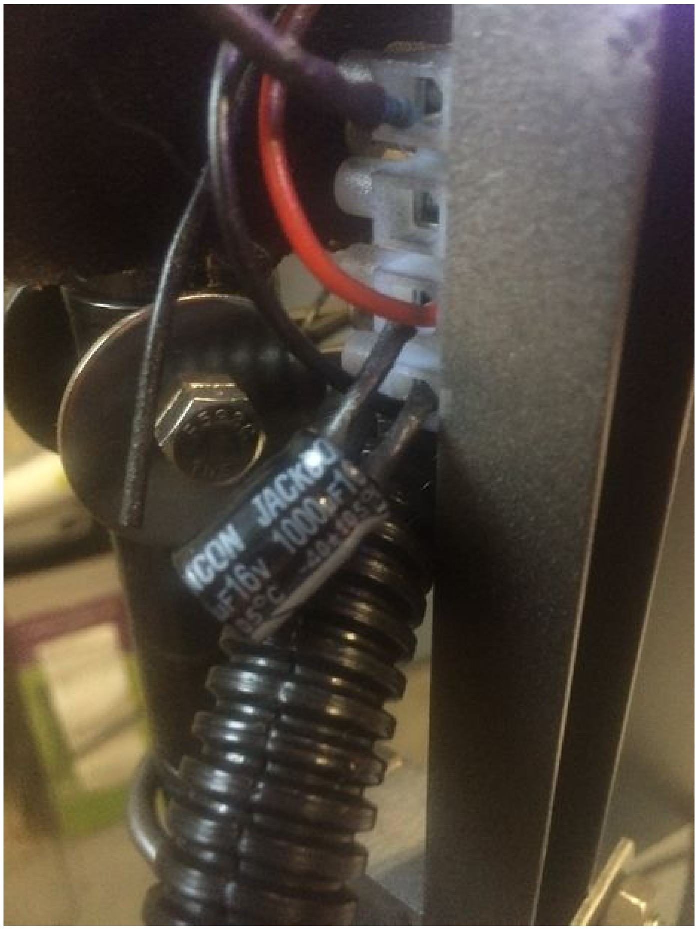


Step 2: Building Big Thermometers

I wanted something large to display temperature on but not some numbers on a screen. Analog was the way to go--most kids have not even seen a thermometer full of mercury that used to be so common. The idea was to build a giant set of thermometers--one for each hand for comparing the chilled hand with the control. A meter of Adafruit NeoPixels 60 LED's was siliconed into a length of aluminum channel. The wires were led out through holes in the back and secured with a connector block. A 1000 micro farad capacitor bridges the power terminals and a 100 ohm resistor protects the data port. In this case I had available meter lengths of Schott lead glass crystal to enhance and refract the light from the LED's. These are no longer made so suitable covers could be scavenged translucent plastic tubes that the new replacement LED fluorescent bulbs come in or a sandblasted Lucite plastic cover panel. The glass covers are siliconed to the channel and to steel end pieces bolted to the frame.

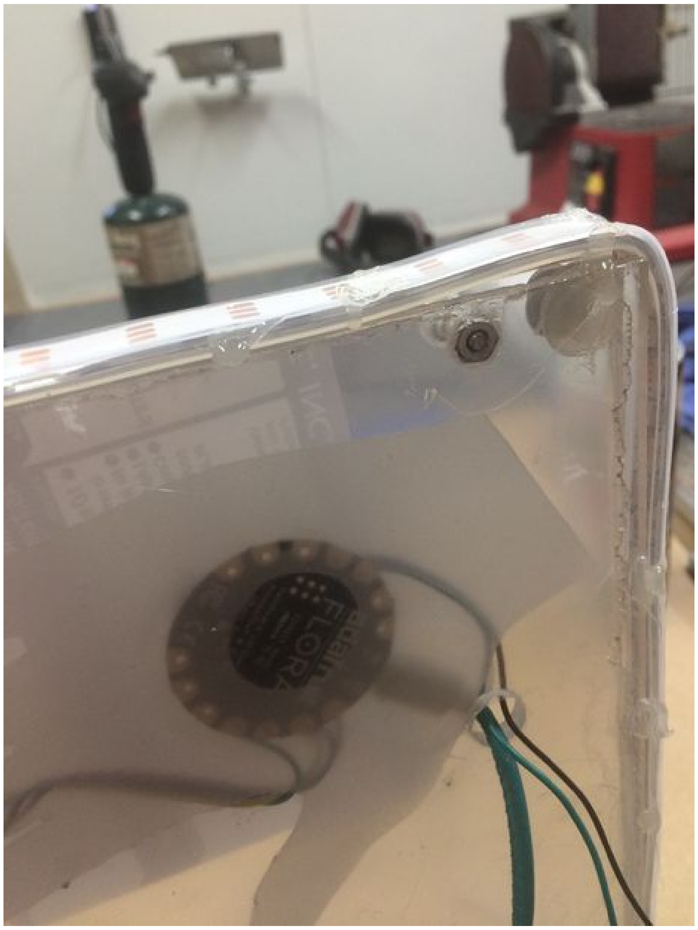


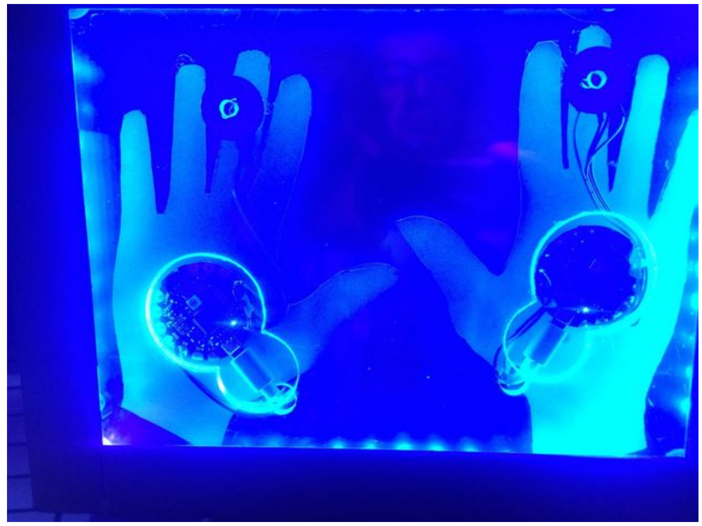


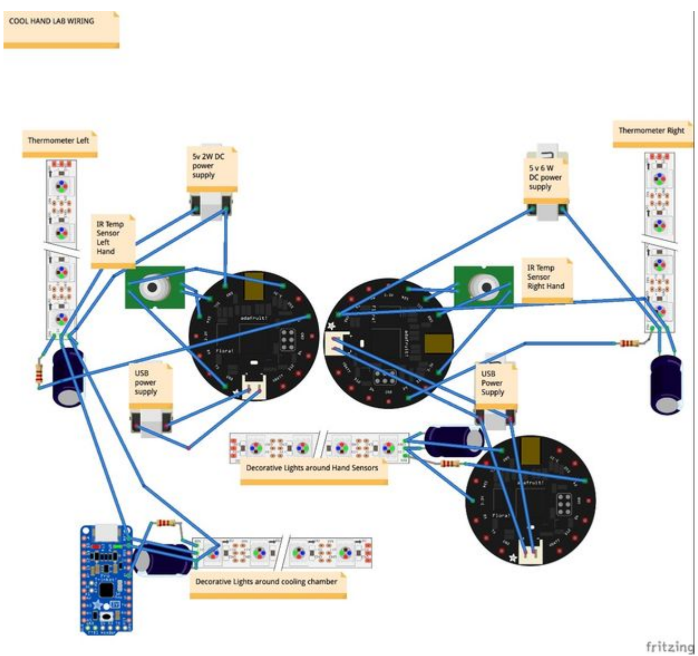


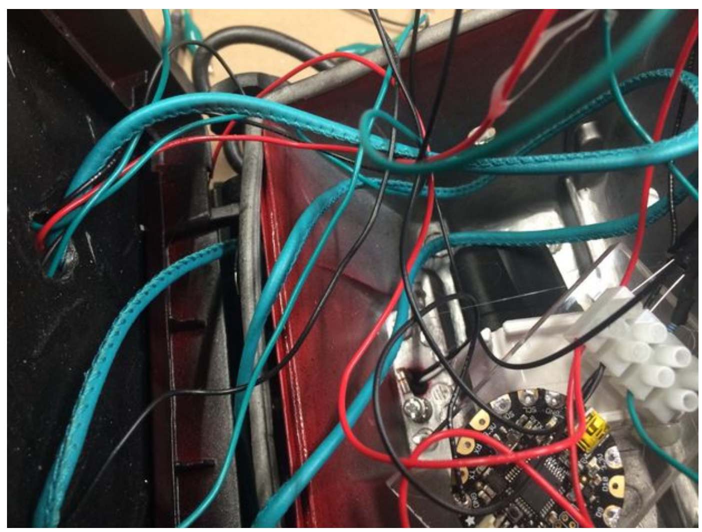
Step 3: Measuring the temp--the easy way

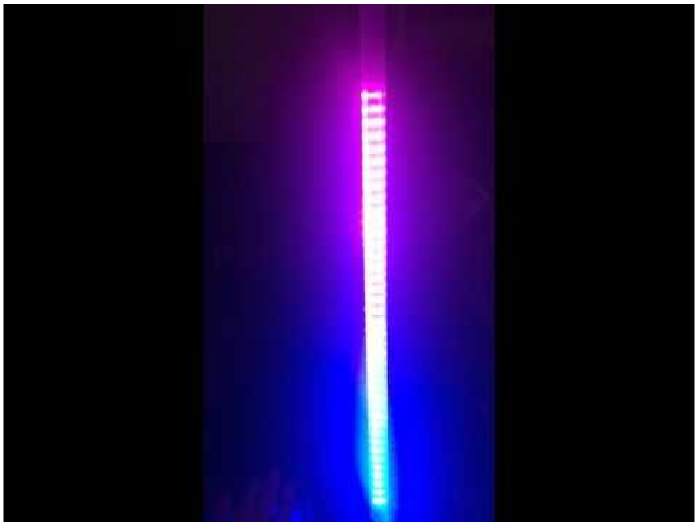
While inserting needle thermocouple thermometers under your skin may sound exciting an easier and more accurate way is readily at hand. The MLX 90614 is a small, very accurate IR thermometer that can be connected to Arduino IDE systems. In this case we used two--one sensor for each hand (they have to be connected by I2C protocol and don't have separate addresses so two separate Adafruit Flora computers were used to read the devices). A case was designed with hands sandblasted into a layer of Lucite--incorporating both the sensors and the Flora computers to run them. A third computer to run the NeoPixel race around the outside was also enclosed. The three layer Lucite sandwich with NeoPixel surround was then siliconed into a aluminum frame. An enclosed electrical box on the back provided USB power to the small computers. The NeoPixels in the frame and the two large NeoPixel thermometers were powered with two separate power supplies. (See Fritzing diagram above) The code was written to control the output to the thermometers and buffer the results to make it most diagnostic in the range of human skin. The code changes the light color of the pixels from a blue output at the bottom seamlessly to a red output at the top. The code is in the last PDF.






COOL HAND LAB WIRING
Thermometer Left
5v 2W DC power supply
IR Temp Sensor Left Hand
USB power supply
5 v 6 W DC power supply
Thermometer Right
IR Temp Sensor Right Hand
USB Power Supply
Decorative Lights around Hand Sensors
Decorative Lights around cooling chamber
fritzing





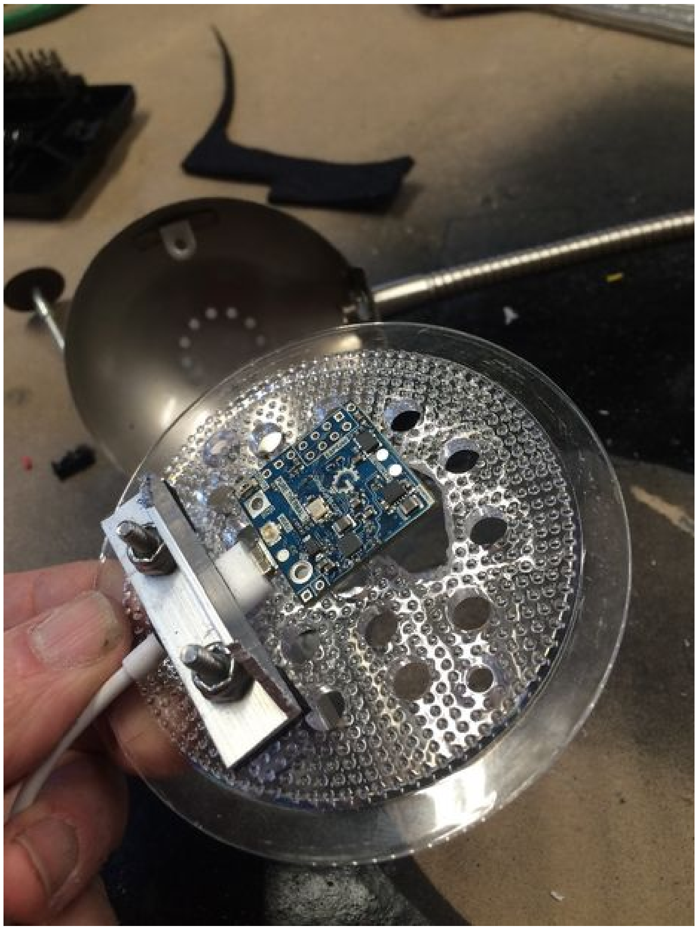
File Downloads

Code thermometer.pdf (32 KB)
[NOTE: When saving, if you see .tmp as the file ext, rename it to 'Code thermometer.pdf']

Step 4: Thermal Imaging

The **FLIR Lepton** camera is a readily available piece of hardware for experimenters use. It provides a low res image of the surrounding thermal landscape which is amazing! You suddenly realize what a limited amount of information is provided by such antiquated devices such as thermometers. You realize that there are hundreds of pieces of thermal data everywhere on your skin. The IR sensors used in the NeoPixel thermometers summarize a large changing area based on a expanding angular cone but the **FLIR** sees contact point data in real time. Getting the data was difficult--currently there are some **FLIR** attachments to smart phones which we didn't use because we would have had a hard time keeping them charged in the exhibit. We choose a **FLIR lepton Smart I/O board** that outputs the images on a USB cable to a computer so that it could be projected on a HDMI monitor for large screen viewing. The unit was locked into a simple cord sandwich with angled aluminum and placed inside the housing of a LED reading light with the guts removed. This enabled the participants to swing the head at will and view hands feet or anything else in the room without endangering the fragile electronics.

The purpose of this **Instructable** was to give people viewing the museum exhibit some insight into the variety of design decisions that went into making it. A lot of new technology is aimed at self examination (Apple watch, FITBIT) and much of it is based on what engineers can sample off you with sensors. Some of this data has value but probably not much in the long run -- to a hammer the whole world is a nail, to a sensor you are only a data point that it can measure.

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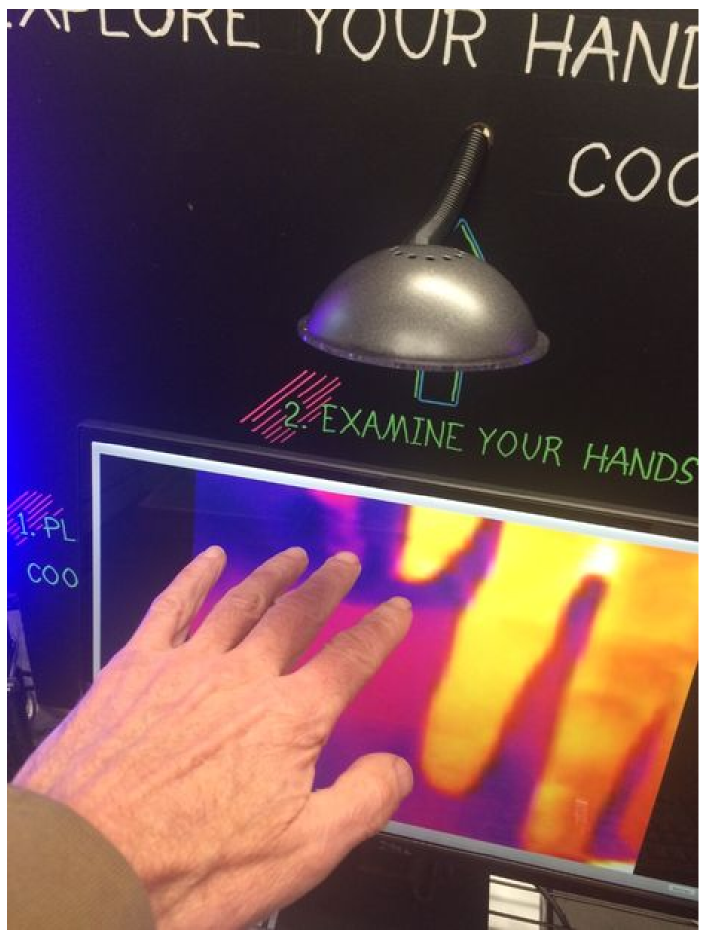
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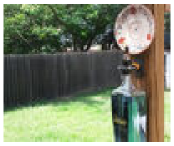

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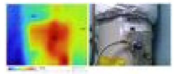

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