NOTE: You should not build this or use these instructions. This is for academic interest only. Electricity can kill. This has no approval or standardization. This plan has not been inspected by any experts and so on.

I have couple of electric smokers like this:
https://www.motonet.fi/fi/tuote/546628/Sahkosavustin-1100-W-putkimalli

A simple device which has a heating element at the bottom. Then a plate for wood which is heated by heater so it will start producing smoke – and a plate for food which is intended to be smoked on top of this.

Problem with the cheap smokers like this is that the heat can't be controlled. The temperature inside my heater increases up to 250 C – which is fine for fish – but way too much for any bigger piece of meat.

Figure 1: Electric smoker

So – I've built a setup where I do not install the handle visible on top of smoker – and I place a K-type thermocouple at the roof of the smoker via the handle screw hole. I've used cheap thermocouples which can be found from example from aliexpress:

Figure 2: K-type thermocouple

I have been using Beagle-Bone-Black https://beagleboard.org/black board computer for processing the temperature, controlling the heater and interfacing towards user:

Figure 3: BBB

Beagle bone black is probably an overkill for the job – but it allowed easy prototyping as it can run mainline Linux/u-boot and provides required interfaces. As a result, it is easy to plug USB WIFI dongle in BBB for WIFI connectivity. The K-type thermocouple measurements can be read via SPI using the MAX6675 chip. BBB has also ADC which I used to read food temperature probe values using simple voltage divider connection. (NOTE: I had problems as I didn't understand the cord/probe of many food probes is connected to GND. I should've connected the food probe to GND side of voltage divider and it would probably have worked better. Now I have only one probe with isolated cord which works at my setup). Finally the GPIOs on BBB can be used to control a relay, to drive LED segment display, to get button presses...

The first version I built used regular extension cord from which I cut a wire and for which I installed a mechanical relay to cut power.

Figure 4: Mechanical Relay

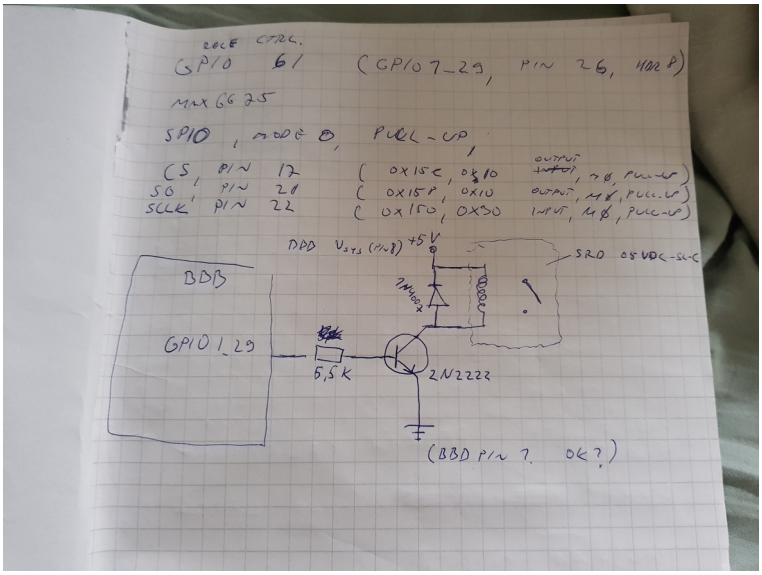
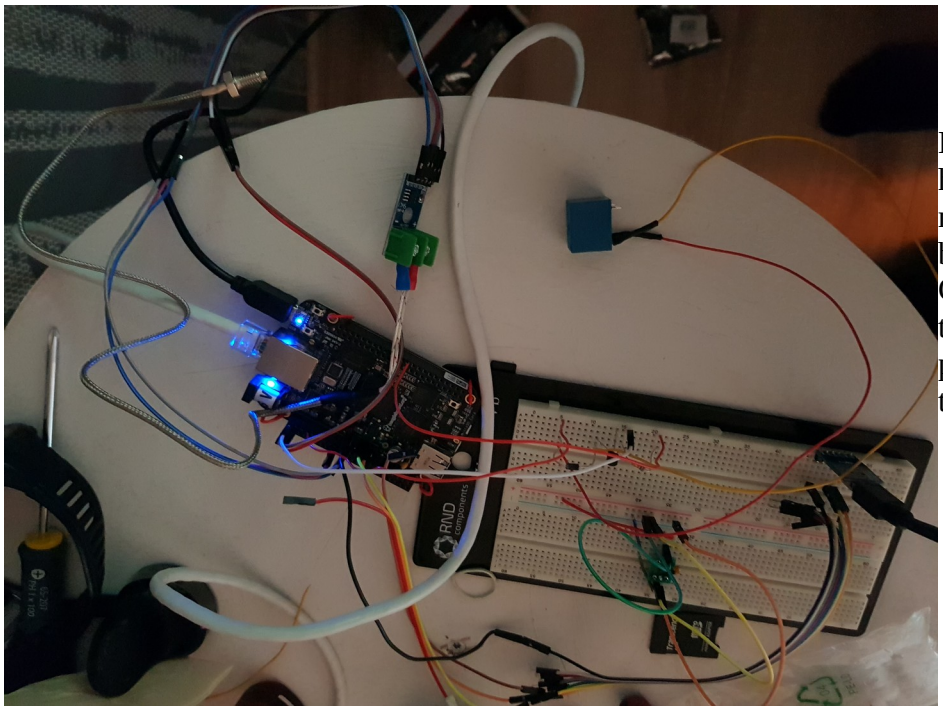


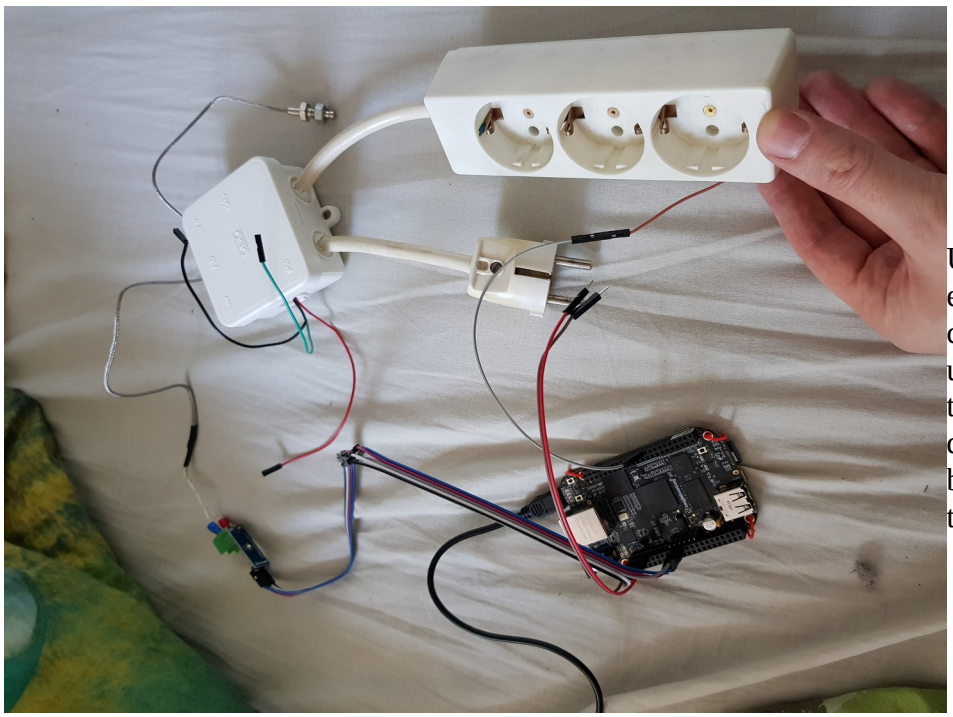
Figure 5: Relay control planning

The relay required more current than BBB GPIO could provide so I had to use transistor as amplifier for control current.



Later I found that there would have been suitable relay modules which could have been operated just by BBB GPIO current. Well, building the amplification and protection was a lesson for me though.

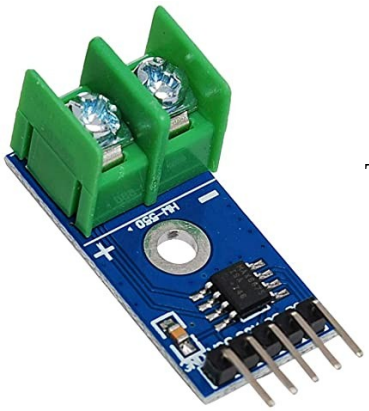
Figure 6: Relay circuit testing



Unfortunately the heater element consumes quite high current and switching it on/off using mechanical relay will kill the relay quite fast. My relay did not serve for too long before it started disconnecting the power unreliably.

Figure 7: Power-cutter v0.1

In order to connect the thermocouple to beagle-bone I forst used MAX6675 module like this:



This module can be directly connected to SPI bus.

Figure 8: MAX6675 module

As a next step I decided to use solid-state relay instead of a mechanical relay to get longer lifetime. I also decided to have my first try with designing a PCB. I also wanted to have all of the ICs on a PCB so that it could all be closed in same mechanics. I also designed support for the food temperature measurement in to device. After some days of designing I had the gerber files and BOM (which are also stored in this repository). I ordered 5 pcs of PCBs:

Figure 9: PCBs

And soldered fuses, relay, connectors, LED, capacitors, resistors pin-headers etc…

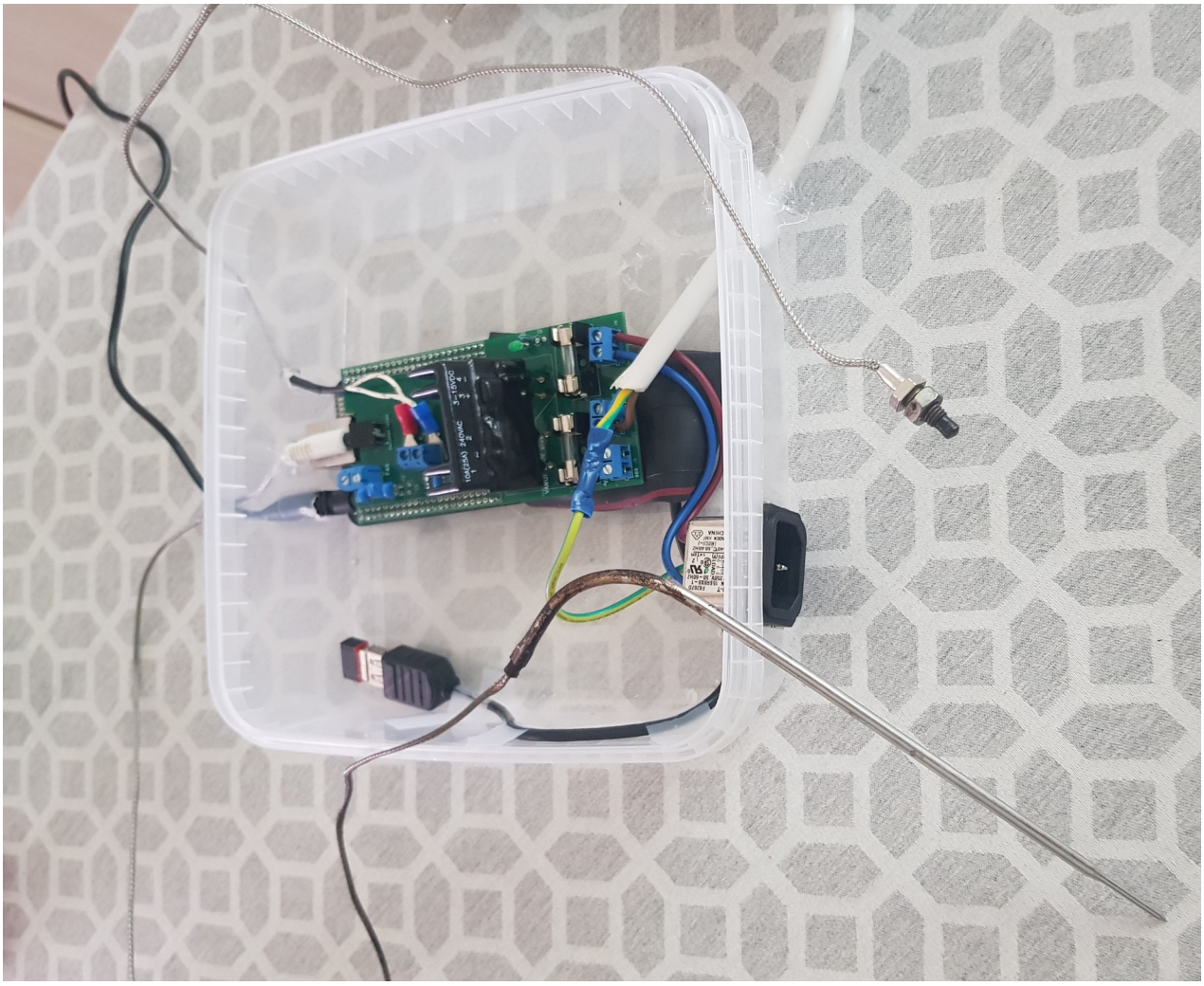
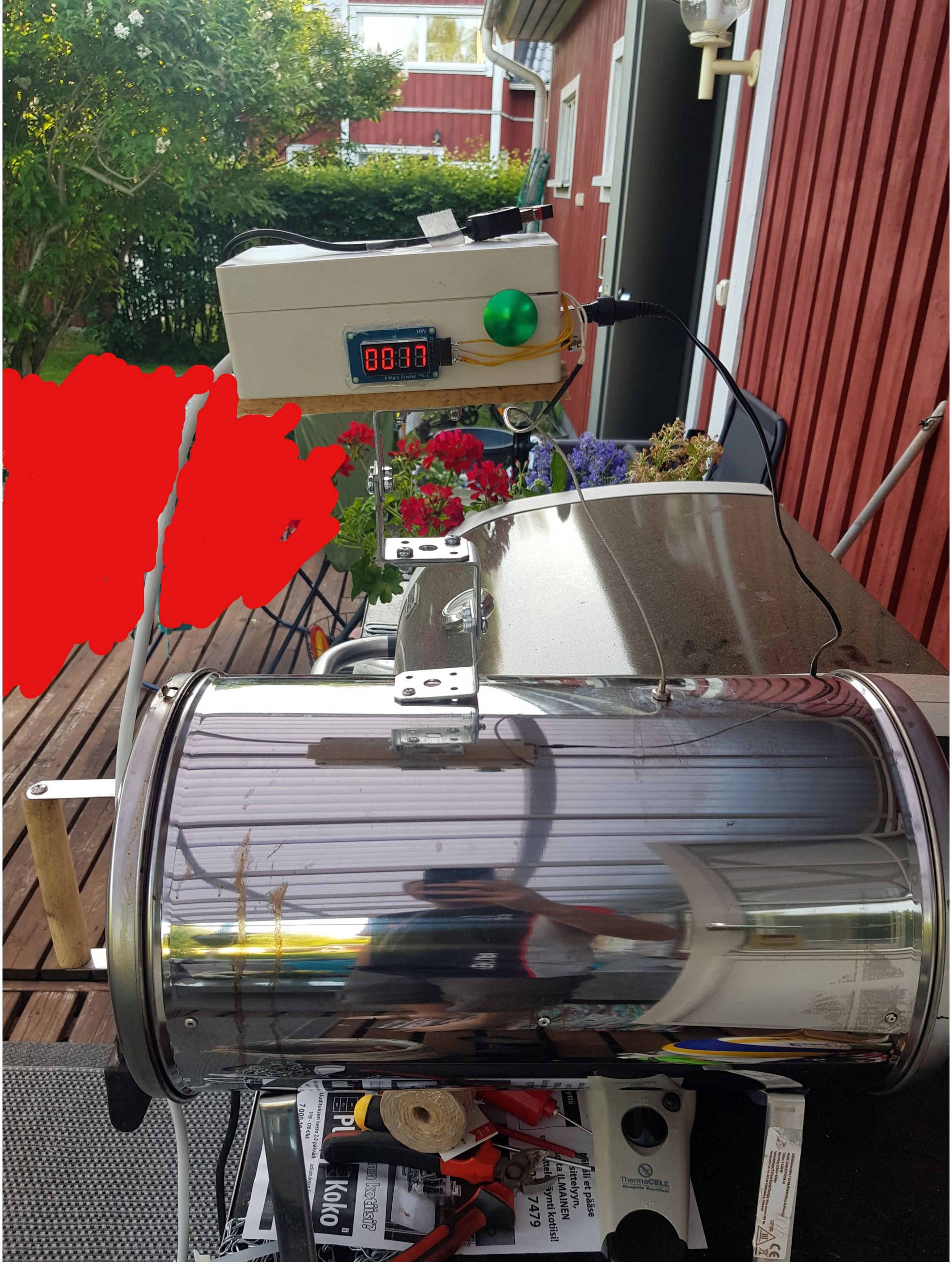


Figure 10: test-run no mechanics

And after it seemed to be working…

Figure 11: testrun with pork

At some point I noticed that WIFI control and monitoring was nice when one was sitting inside – but when it was sunny and warm summer-day I usually was tinkering with something at the backyard. When I wanted to see what was the temperature in smoker – or whether the food was reaching wanted temperature I had to get my mobile phone and open the web-browser. Not fun. Also, shutting down the beagle had to be done via web interface. Just to overcome these inconveniences I did install a LED segment display and a button (with jump wires to BBB GPIO + hot glue) to the control box.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