

THE NEW EXPRESSO

Linear CCD array that reads fluid level
of a capillary

Modular design – easy to move around
and change position

Functional in optogenetics setups –
box designed to keep out light

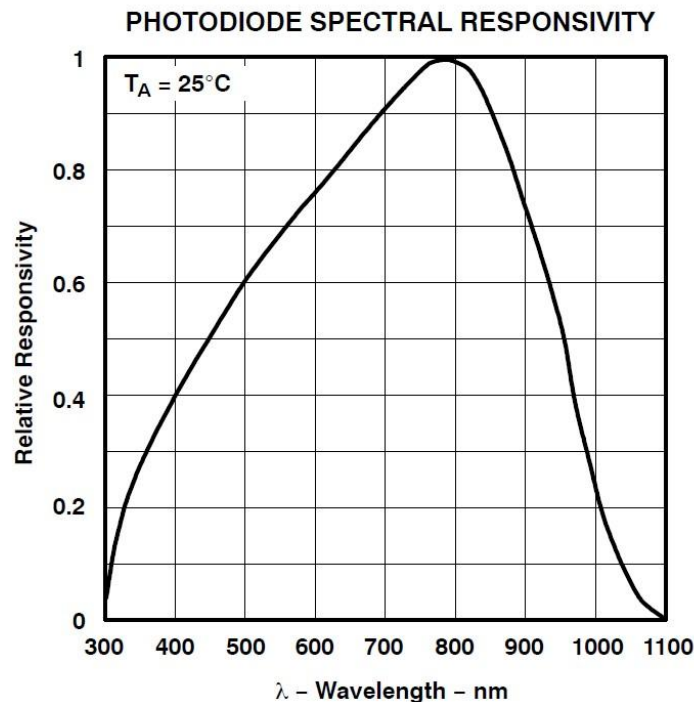


TSL1406R (old sensor)

Using this on the current Espresso setup

Obsolete – no longer manufactured

Good imaging length

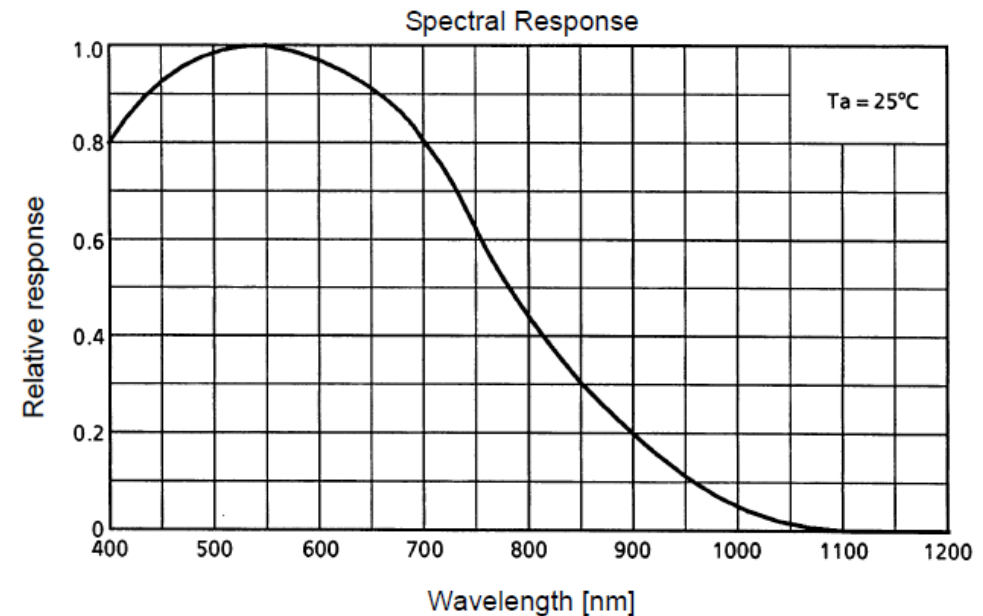


TCD1304DG (new sensor)

Firmware & PCB completed/functional

Higher resolution image (3648 pix)

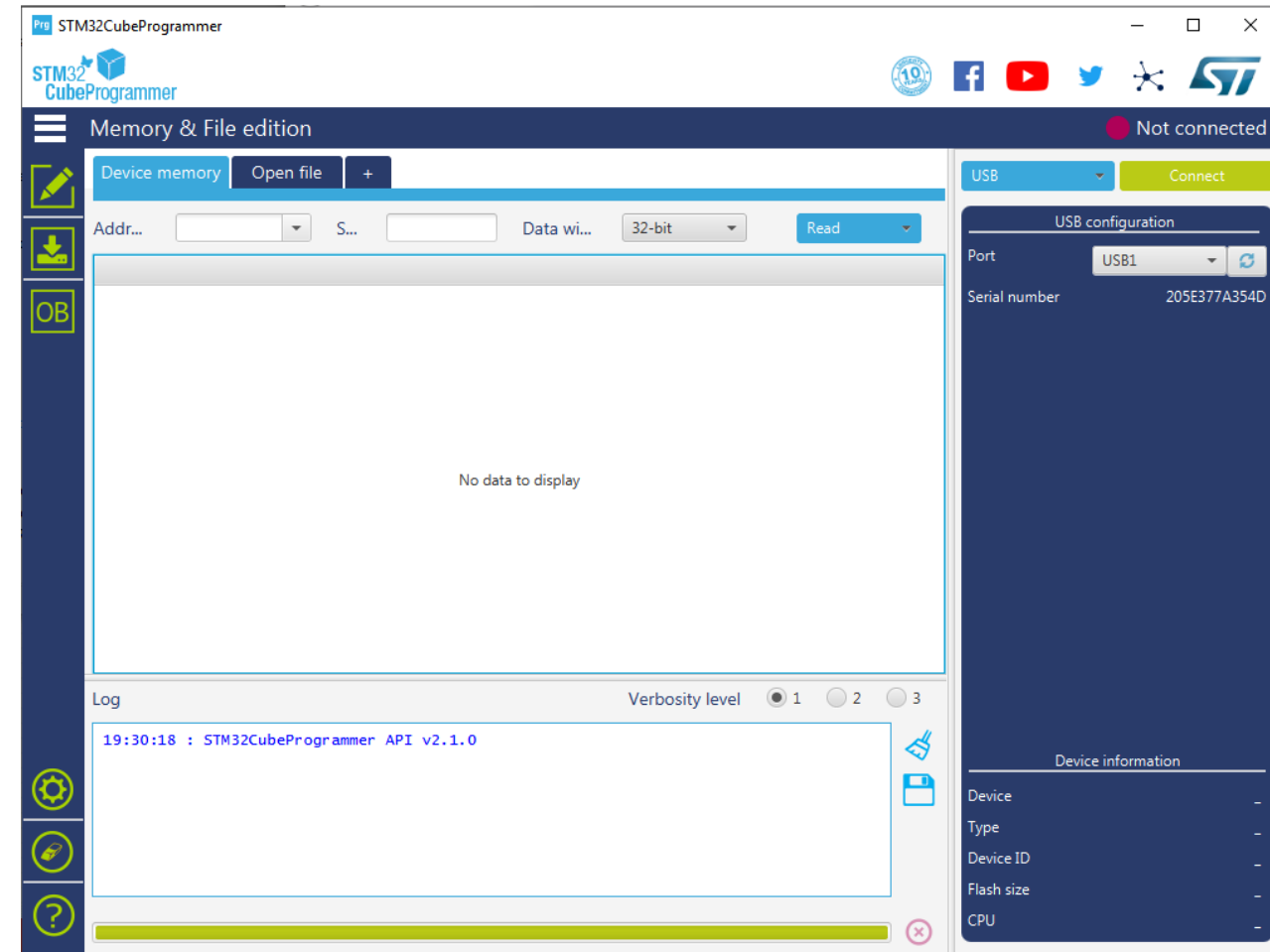
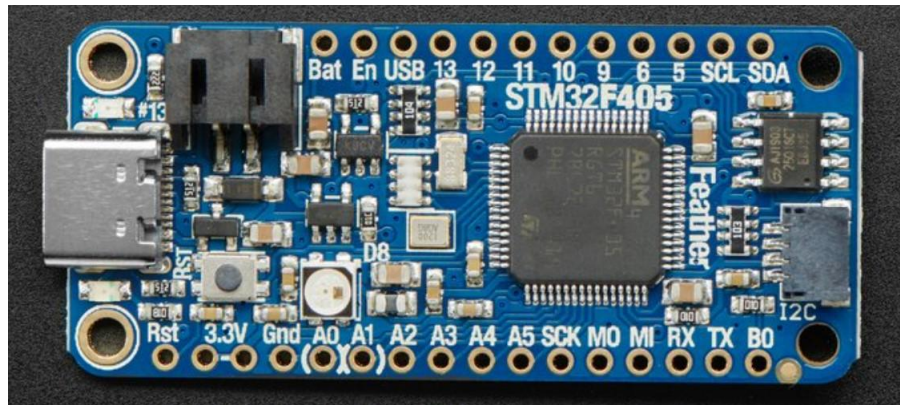
Shorter but okay imaging length (29.1mm)



MICROCONTROLLER

Using the Adafruit Feather STM32F405 Express

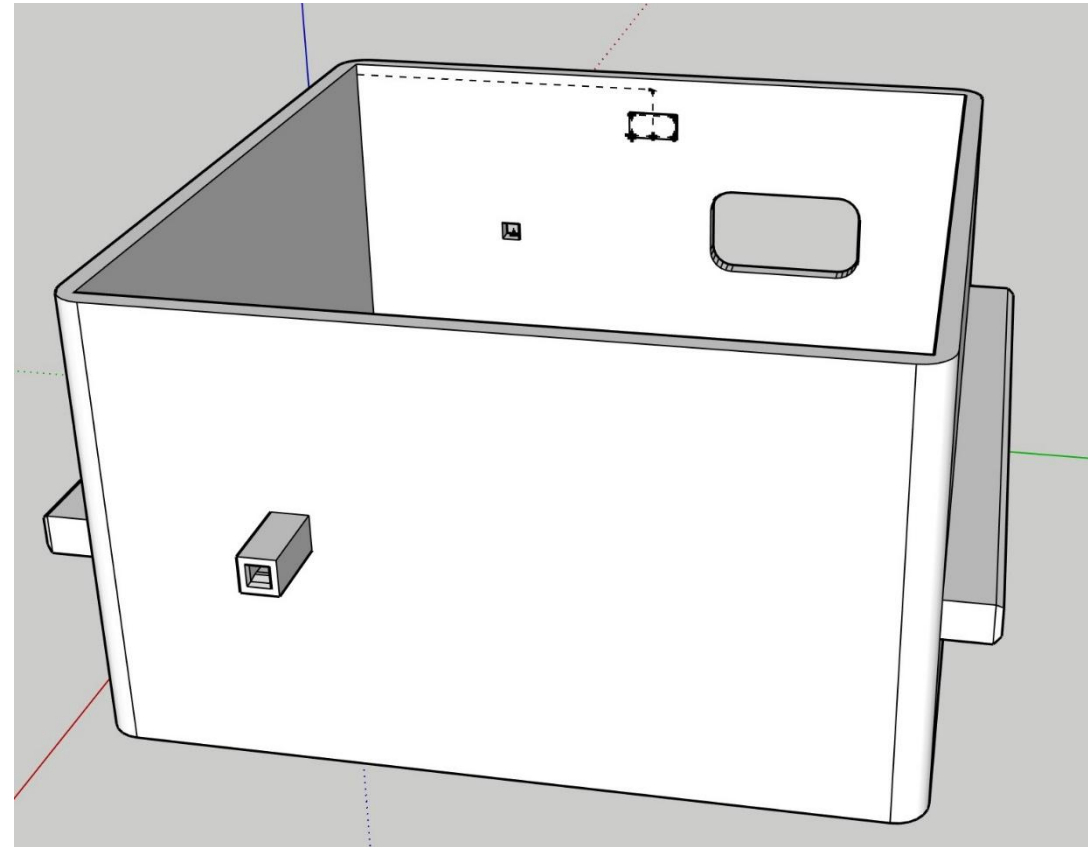
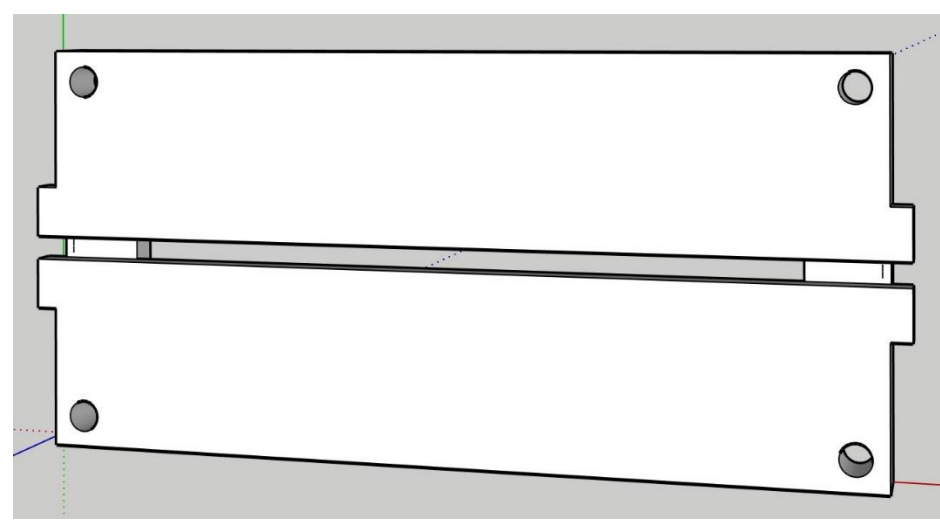
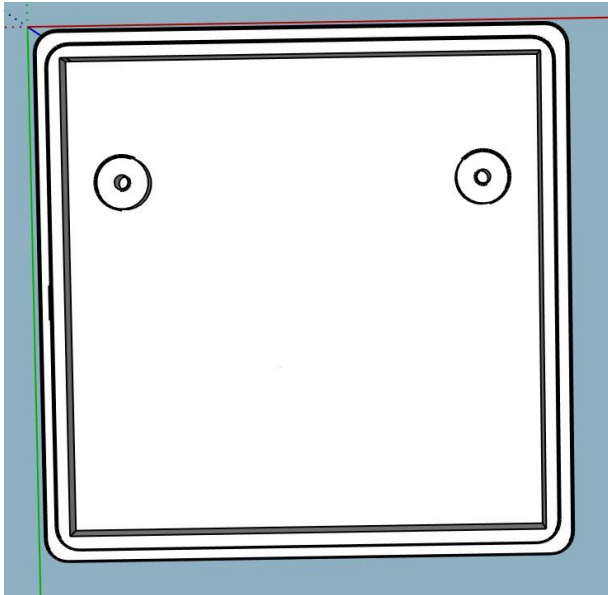
- Powered via USB-C
- Has a +5V pin
- STM32F405 processor operates at 168MHz
- Can program with DFU Bootloader via STM32CubeProg



CASE DESIGN

The case has three parts:

- Lid – LED PCB attaches to this
- Box – Holds electronics
- CCD Cover – blocks stray light



NEW LED ARRAY

Pros:

- IR LEDs don't interfere with flies
- Diffuser spreads light more uniformly
- Frosted acrylic sheet (~3mm)
- LEDs and PCB both powered over USB

Cons:

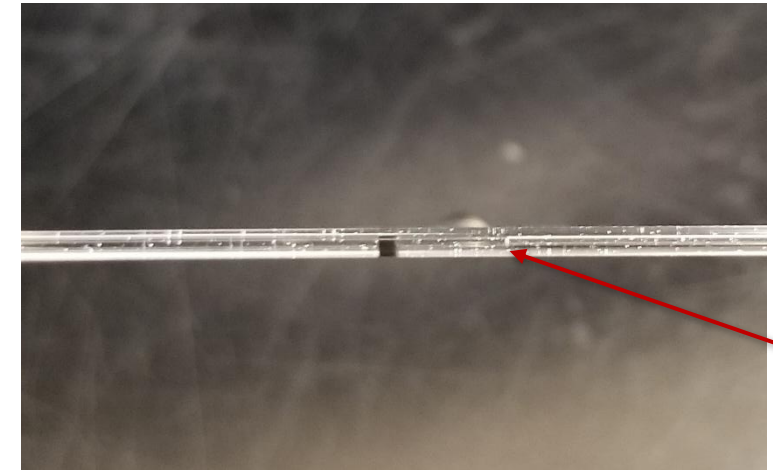
- IR Lights produces more noise due to longer λ
- Can't tell by eye if IR LEDs work



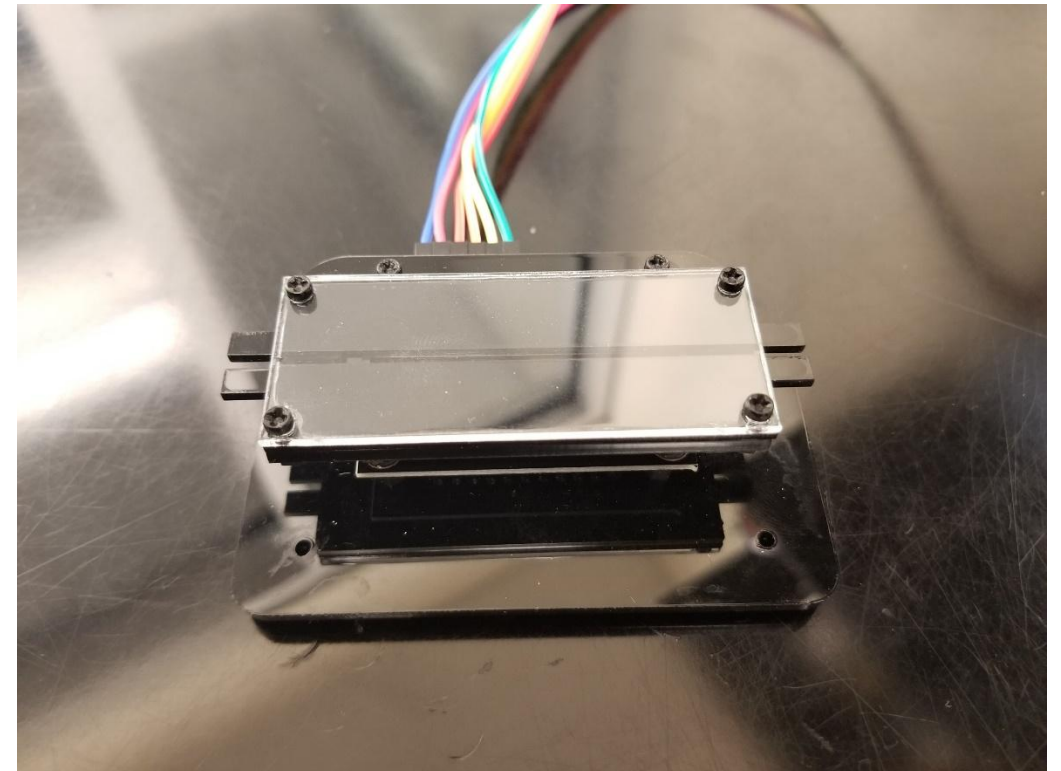
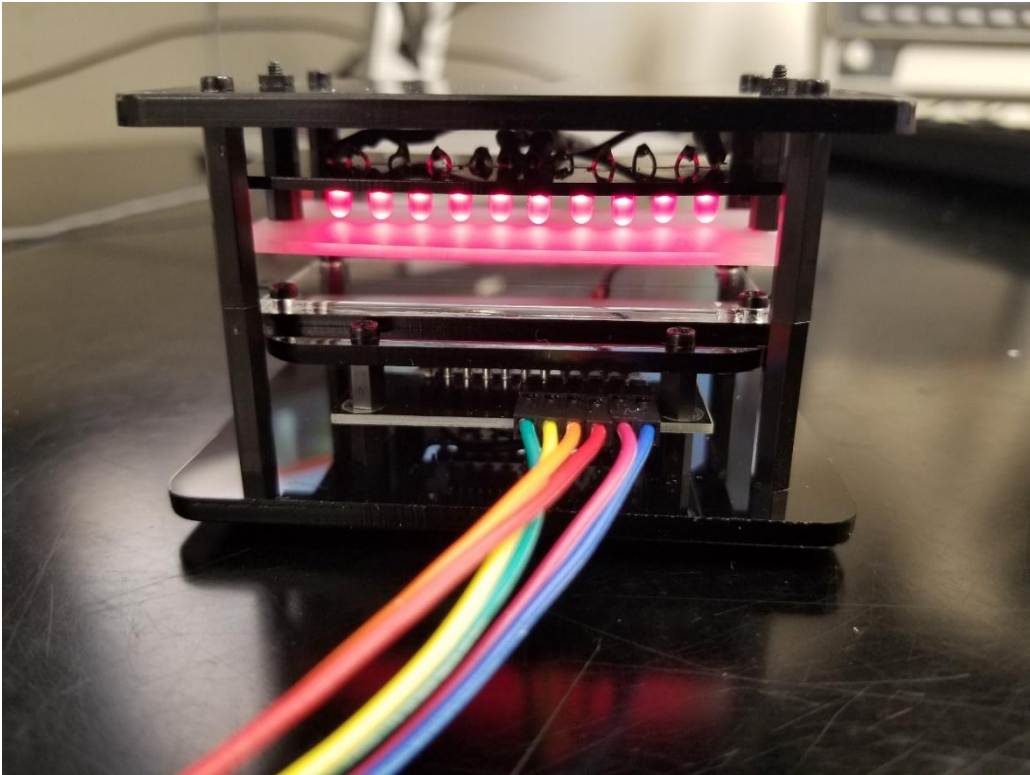
PROTOTYPE EXPRESSO

Useful for calibrating GUI or images of capillary

Produces a clear crisp image (red LEDs vs IR LEDs)



Water's
Meniscus



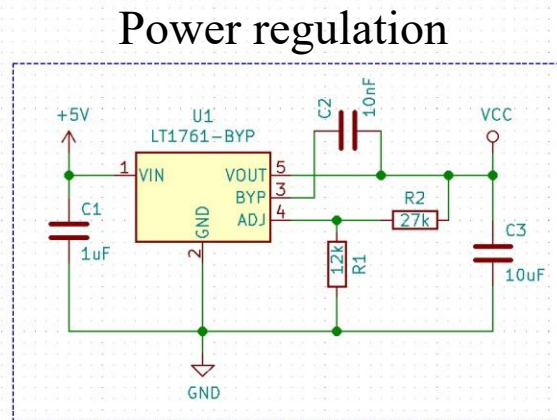
CCD CIRCUIT

Provides voltage regulation and buffering on CCD circuit board

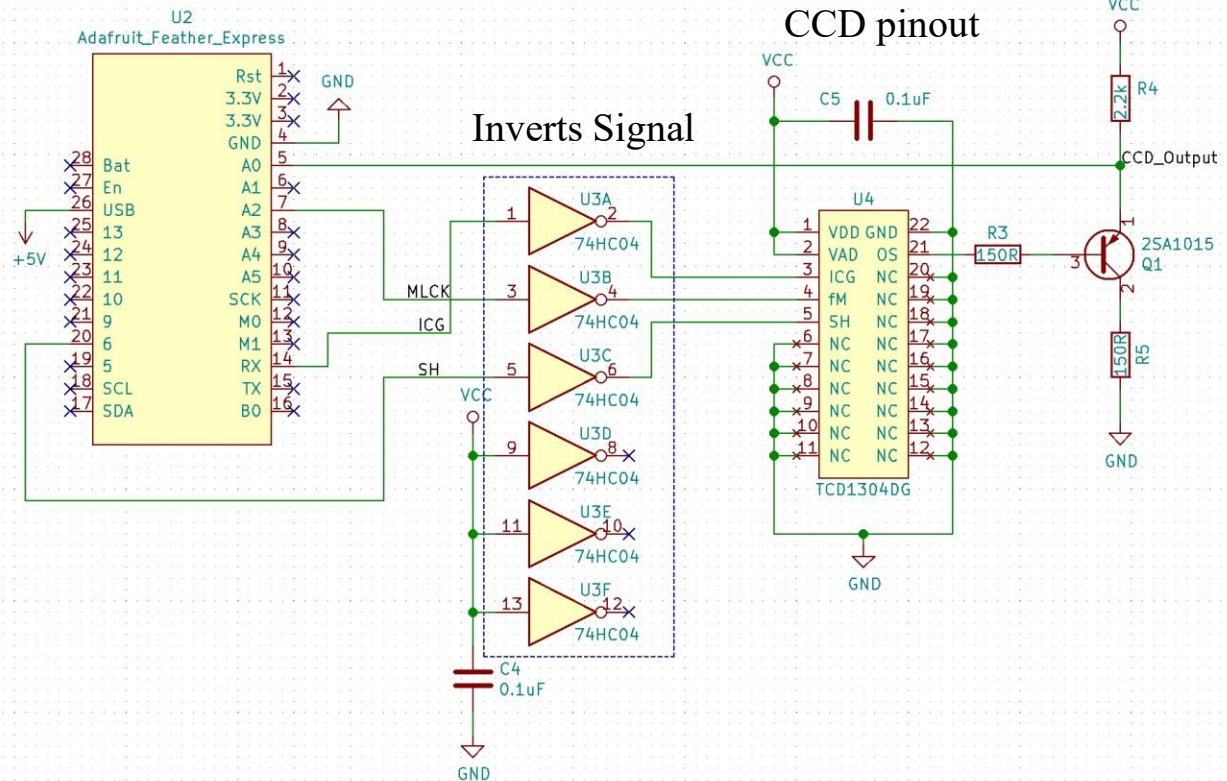
Some basic signal processing on the PCB

Provides voltage regulation and buffering on CCD circuit board

Some basic signal processing on the PCB



Voltage Regulator optimized to reduce the circuit noise.



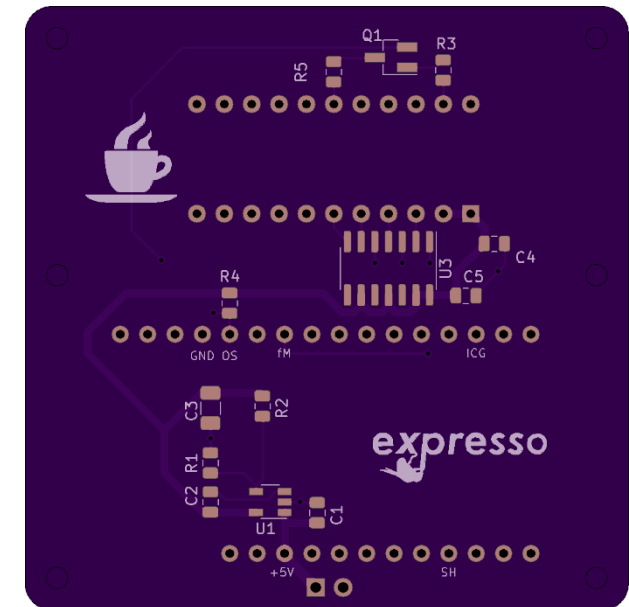
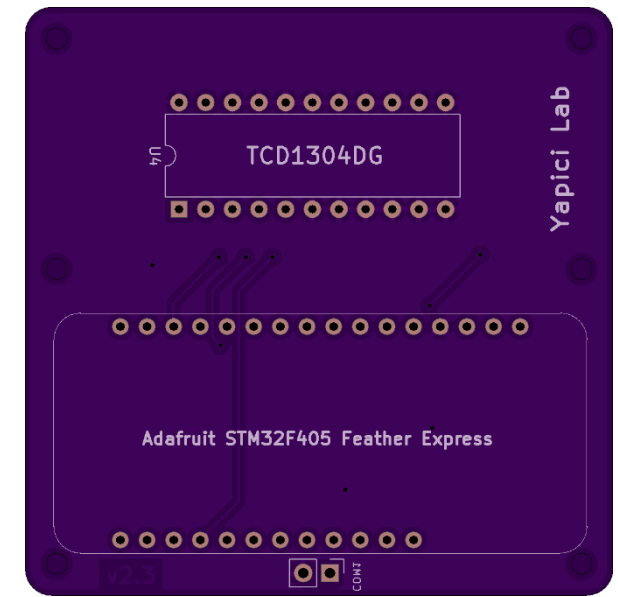
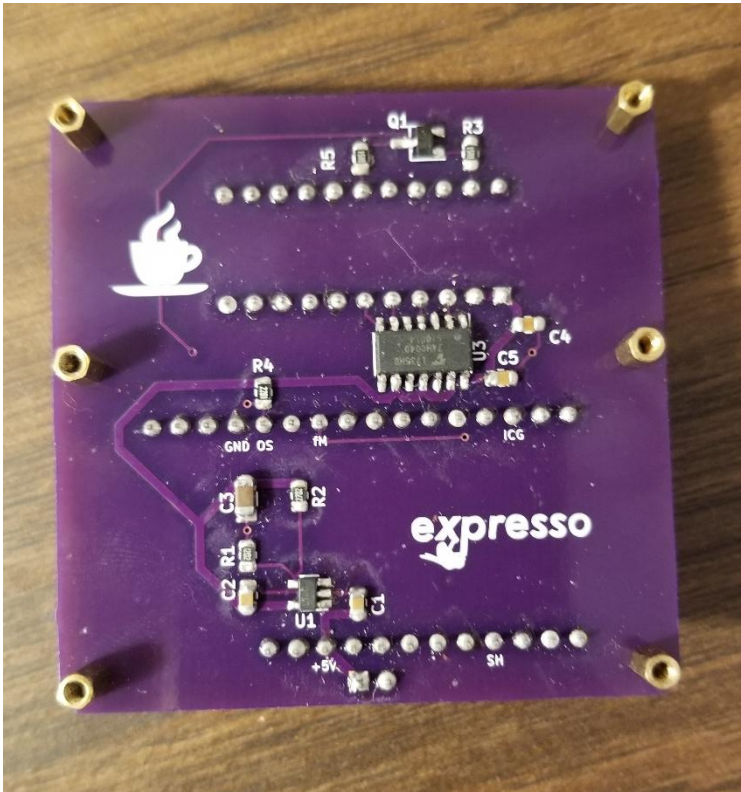
PRINTED PCBS

Feather board and CCD on same PCB

Nearly identical to the prototype

Connects to the LEDs

Small and compact design



LED CIRCUIT & PCB

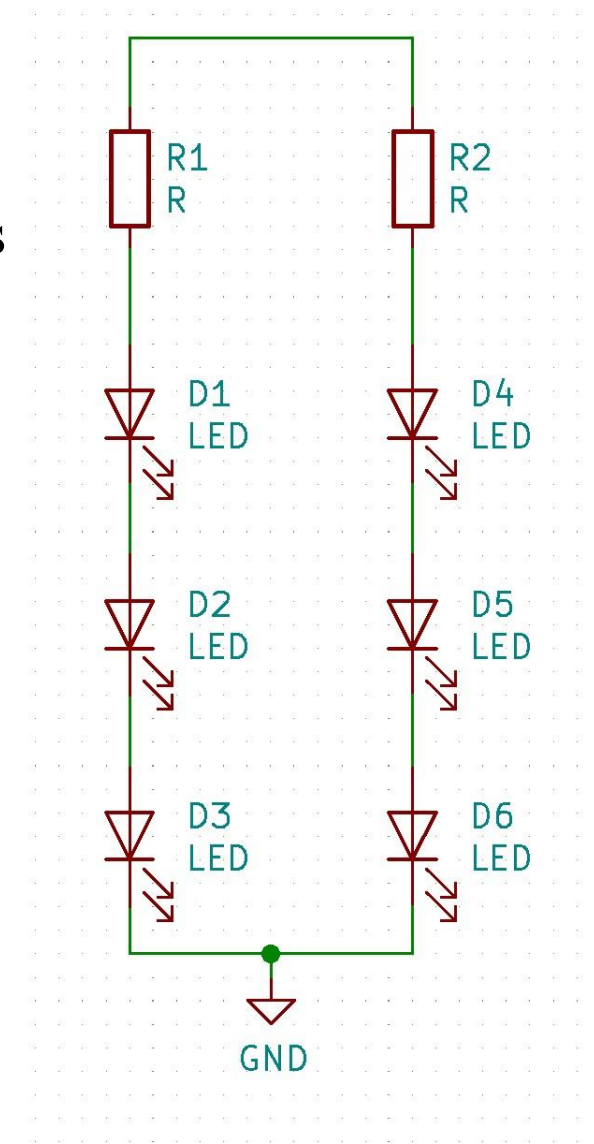
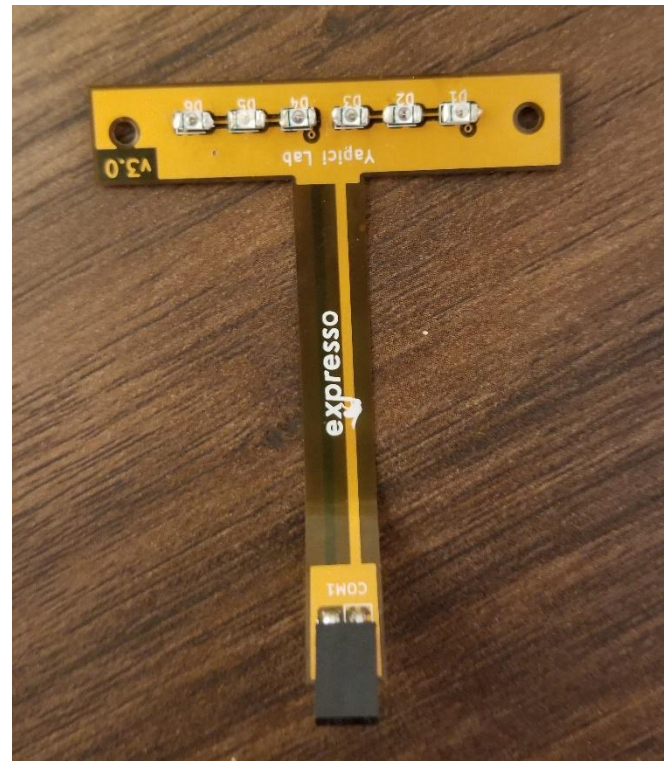
Made from OSH park flexible PCB

IR LED in series and in parallel

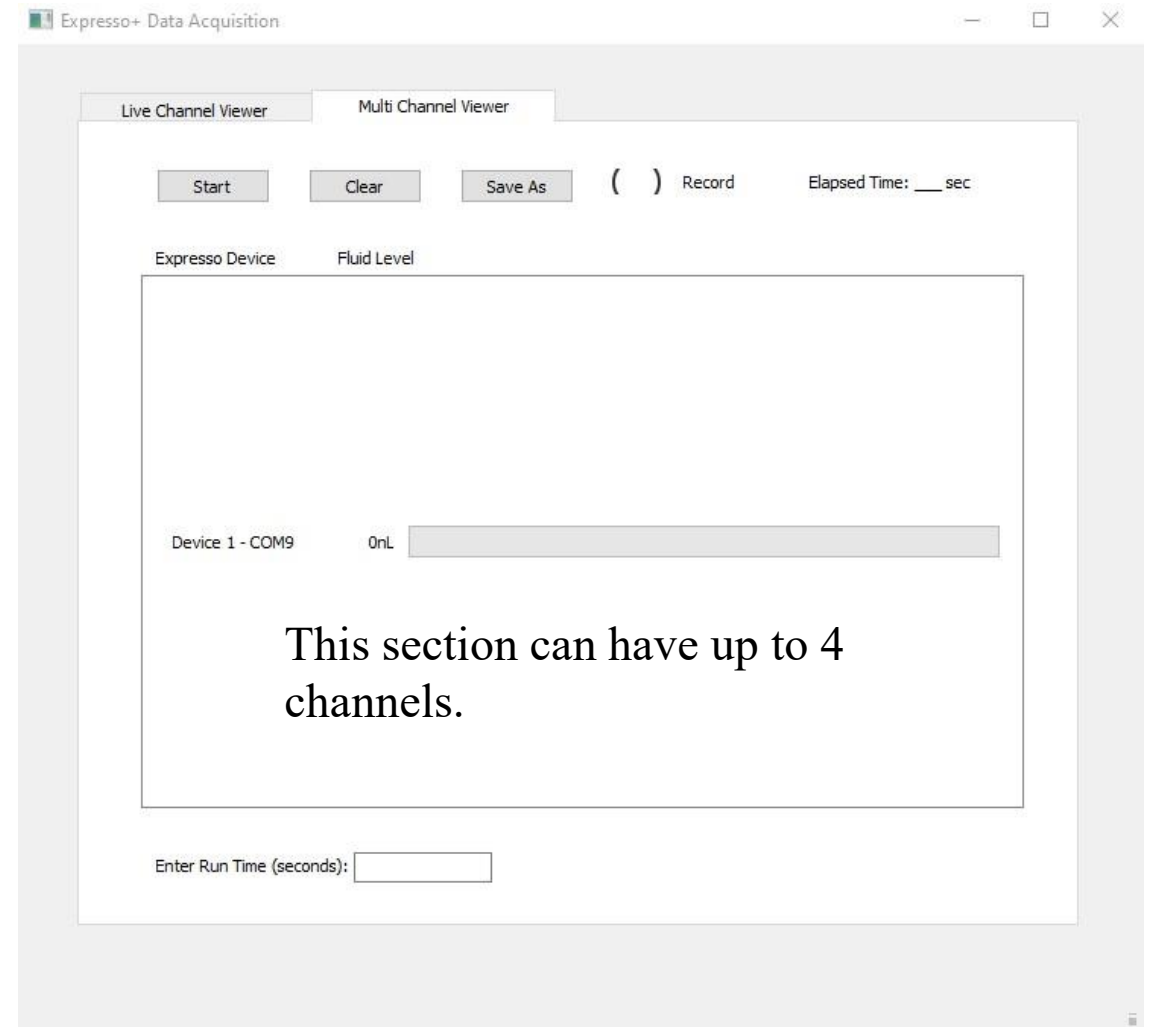
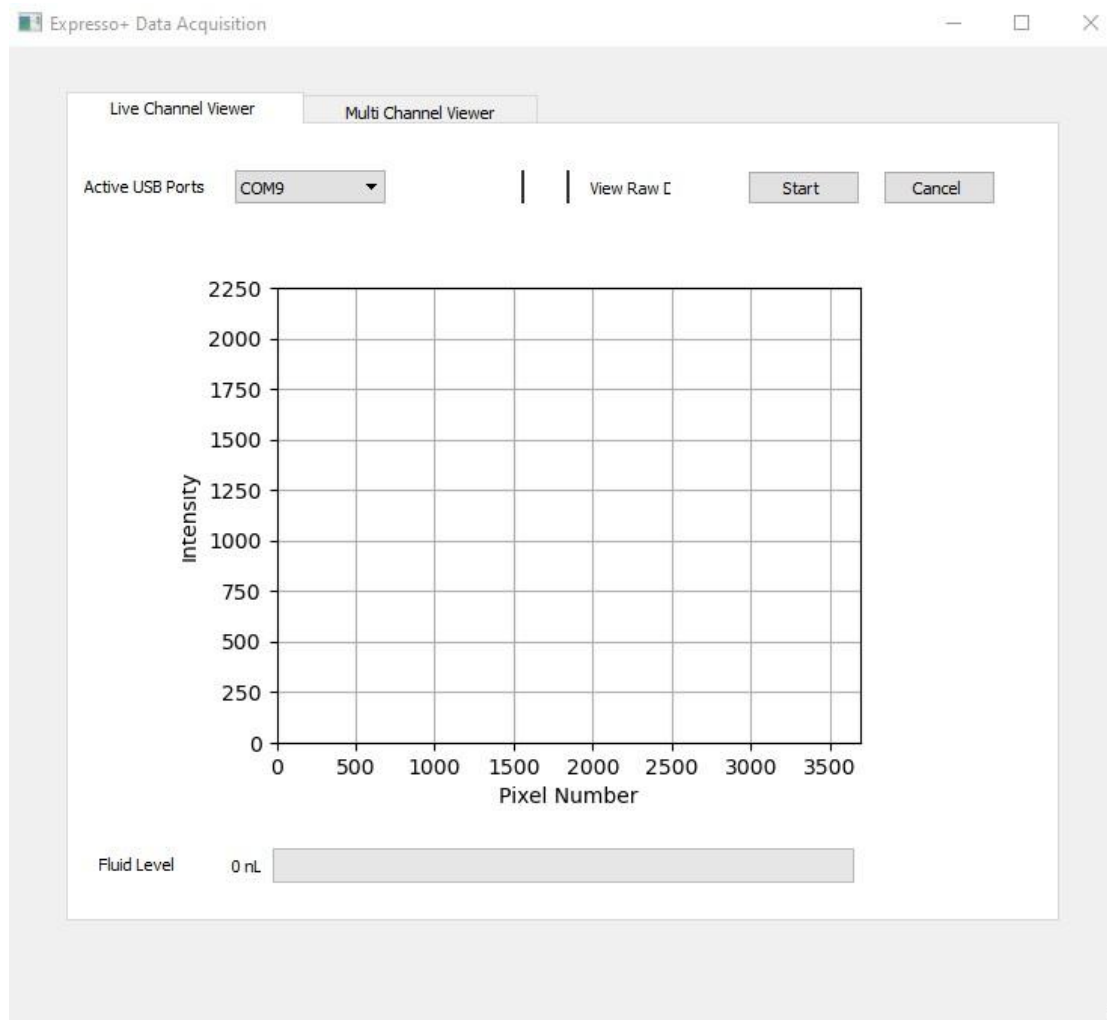


Resistor 220Ω sets brightness

Flexibility posed challenges

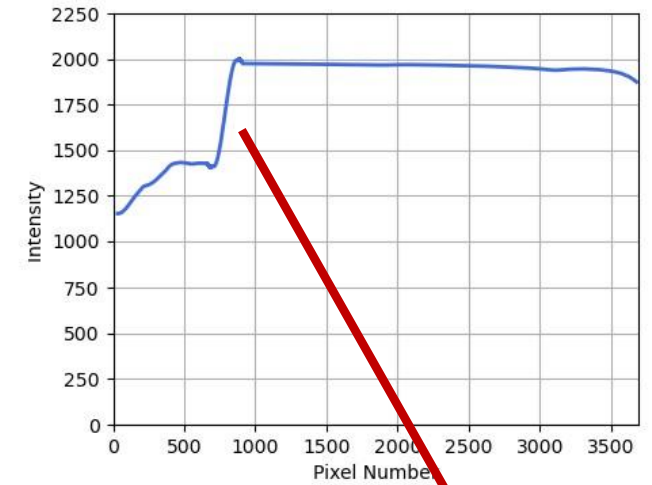


LAYOUT OF NEW GUI

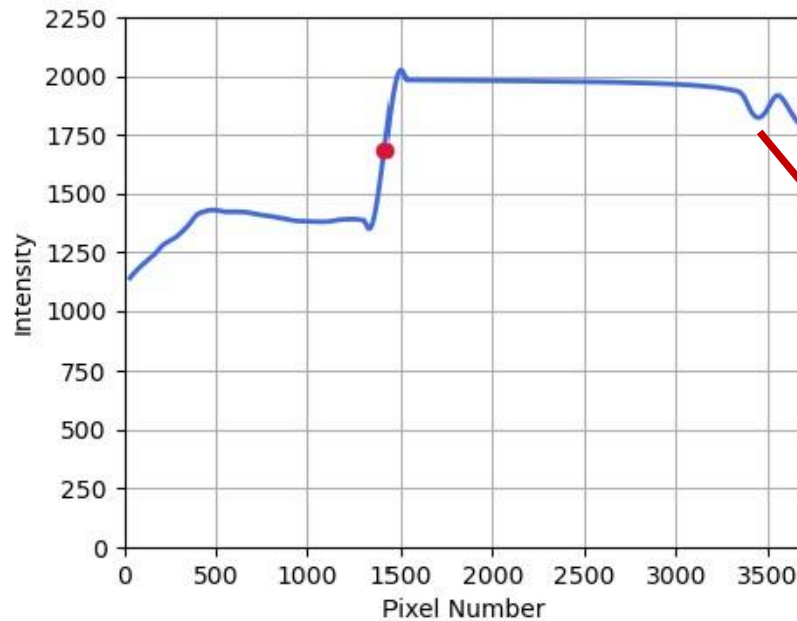


EDGE DETECTION

GUI's Live Channel View shows live plot and fluid level

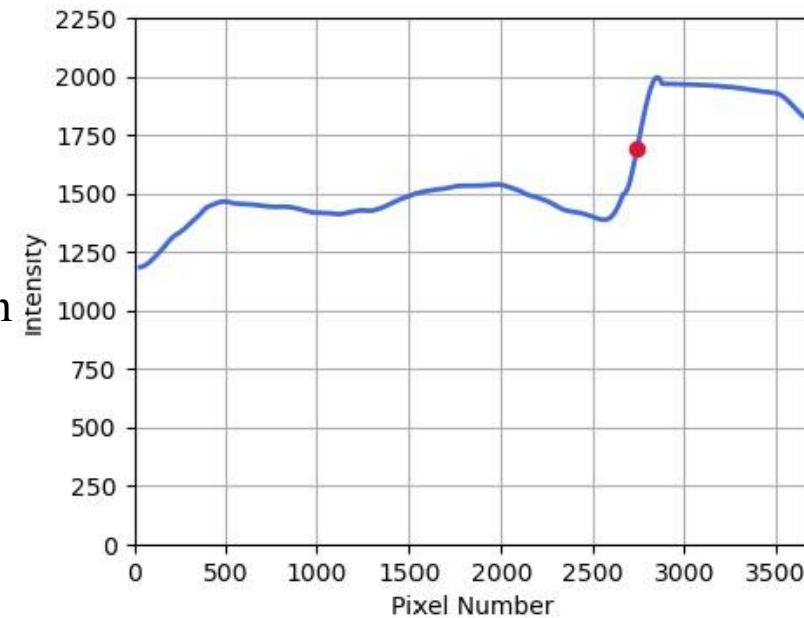


Fluid 0 nL



Black line on
capillary

Fluid 1627 nL



Edge not
detected because
it is too far to the
left.

Fluid 660 nL