PROJECT PORTFOLIO

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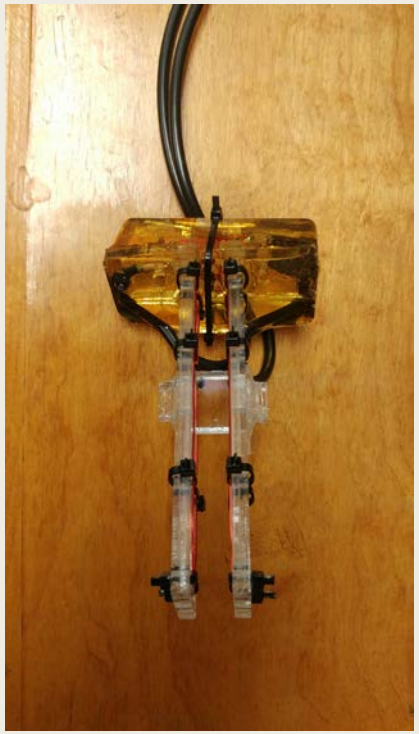
CONTACTLESS CONDUCTIVITY SENSOR

Corrosion-immune and biofouling-resistant sensor for measuring conductivity in natural or urban freshwater systems

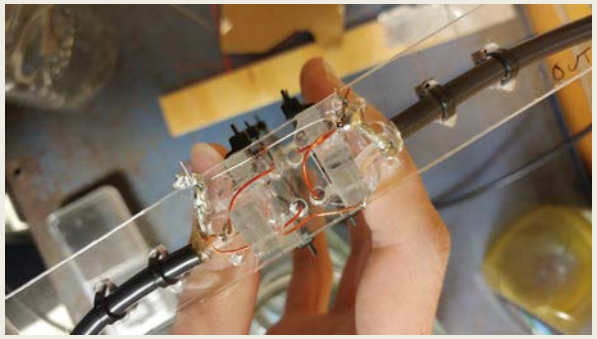
Github repository: Pending

Acknowledgements: Thanks to Dan Furuta for collaboration, thanks to Hanna Lin for moral support

Project Dates: Jan. 2017 - Current

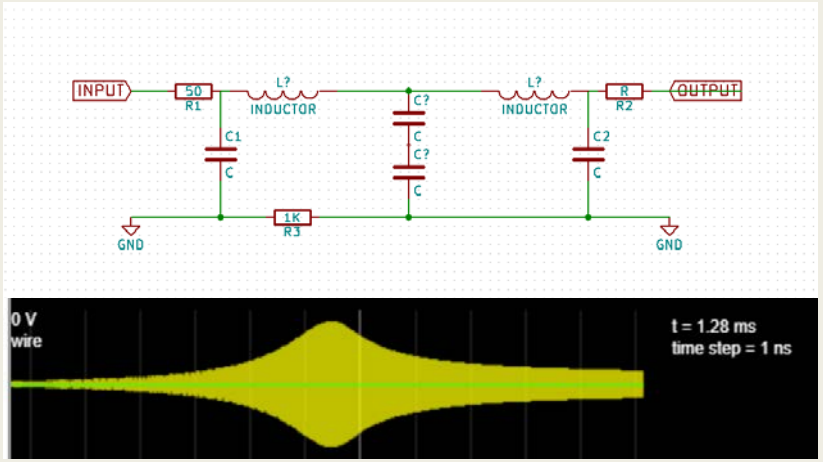


The prototype sensor. The exposed circuitry has been potted in epoxy resin for waterproofing.



View of probe connections in the prototype sensor.

This ongoing project is for my Masters thesis at the University of Minnesota. The goal was to create a cheap and more rugged alternative to conventional water conductivity sensors, which are often susceptible to corrosion and fouling despite being quite expensive. This flaw is usually due to the direct contact of metallic components with the water required to measure electrical resistance (used to calculate conductivity), which I have avoided in my design by measuring electrical impedance instead.



Top: Empirical schematic of the conductivity sensor. Only the resistor R3 exists as a lumped-element in the actual sensor; all other components exist as distributed elements in the sensor itself, its feedlines, or the water.

Bottom: Output of a SPICE simulation of the sensor in mildly conductive water. The x-axis is frequency and the y-axis is voltage. As a sweeping sine signal is applied to the sensor, the magnitude of the peak in the output corresponds to the conductivity of the water.

ISCO PROGRAMMING CABLE

Functional equivalent to the automated water sampler “interrogation cable” made by Teledyne-ISCO

Github: https://github.com/KeiranCantilina/ISCO-programming-cable

Acknowledgements: Many thanks to Dane Kouttron for insight about the connection sense mechanism and the compatibility of 5V signals with 12V RS-232

Project Dates: Sept. 2017

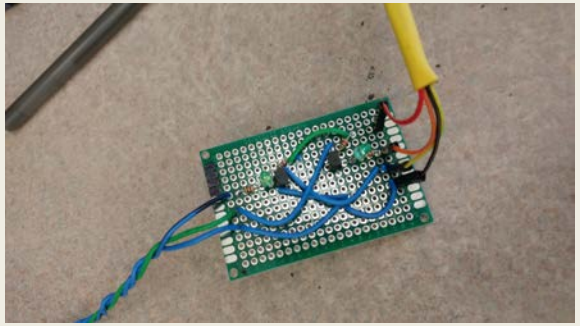
A 6000-series ISCO water sampler.

6-PIN FEMALE, SEALED

A	Switched +12 volts DC
B	Ground
C	Connection Sense
D	Transmit
E	Receive
F	NC

Above: This was the only information about the “interrogation port” found in the service manual.

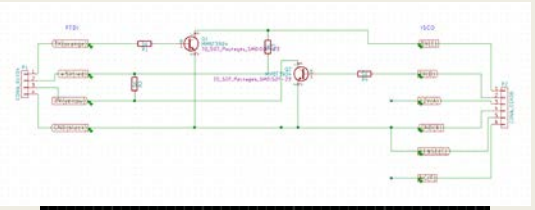
The finished USB to ISCO cable.

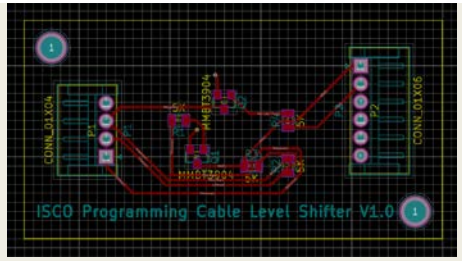


My DIY 5V TTL to RS-232 level shifter.

This was a project I did for work. A hydrology lab next door lost the cable they used to download data from their water samplers, and they needed a replacement.

I found that the cable was, at heart, a USB to serial converter. The replacement was made with a FTDI USB cable, a bit of level shifting circuitry, and the correct connector rigged to trick the ISCO into thinking the original cable was connected.





Schematics and PCB layouts I drew in KiCAD for making it possible to have the cable mass-produced.

THE SCAMERA

Microtek ScanMaker 4900 flatbed scanner modified into a large-format VIS-NIR multispectral camera

Full-resolution project images can be found at:
https://drive.google.com/open?id=11ls2AhE8IGYdJVQsz3RzfAySejQ5RCwX
Note: Many images produced by the camera have a 1:5 pixel aspect ratio

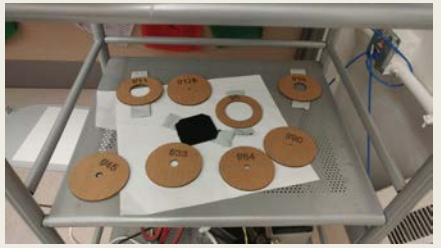
Project Dates: Nov. 2017 – Current

Above: Photo taken of an outdoor area at the University of Minnesota. Note how moving objects are distorted because of the way the scanner images from left to right.

Above: A NIR/VIS landscape shot taken through a window. The artifacts are from the window screen and muntin bars.

Left: The Scamera uses a 330mm doublet lens from an abandoned overhead projector. The modified imaging assembly is so sensitive to IR that cardboard isn't sufficiently opaque, hence the foil.

Above: The Scamera is mounted on a cart with a 12V battery and inverter to make it barely more portable.



Above: The only way to control exposure and depth of field is through these laser cut cardboard apertures because there is no shutter.

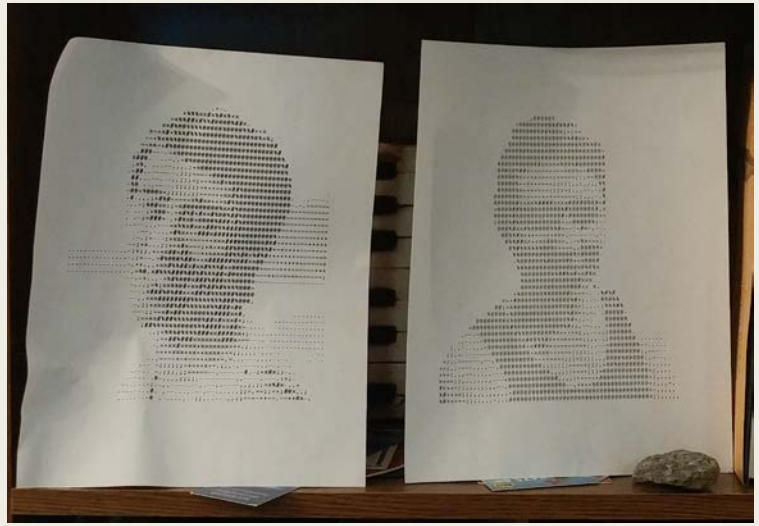
This project began as a just-for-fun repurposing of an obsolete scanner, but I soon discovered that the linear CCD in this scanner is very sensitive to near-infrared (NIR) wavelengths. This sensitivity, along with the high resolution of images produced by the Scamera, means that I can potentially use it to measure the health of crops in fields by measuring the Normalized Difference Vegetation Index (NDVI), which is based on relative Red/IR reflectivity of plants.

PORTRAIT-PRINTING TYPEWRITER

Brother SX-4000 electric typewriter modified to print JPGs as ASCII text

Code and project files can be found at:
https://github.com/KeiranCantilina/Typwriter-Portrait-Project

Project Dates: Aug. 2017 – Sept. 2017

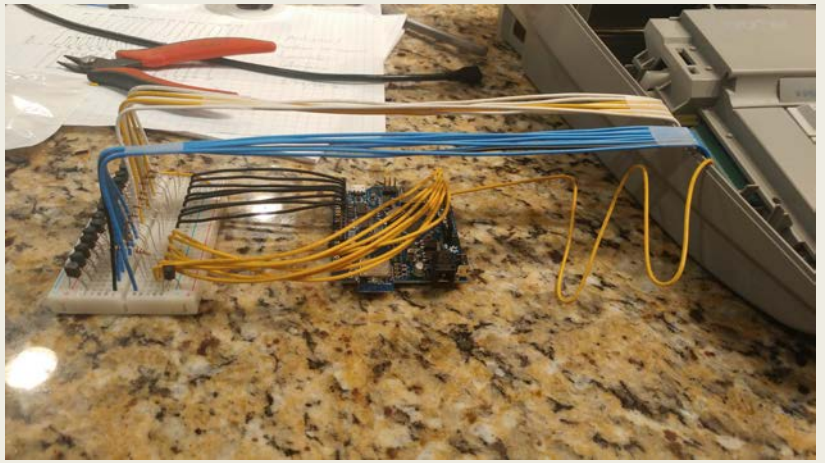


Above: Portraits printed by the typewriter.

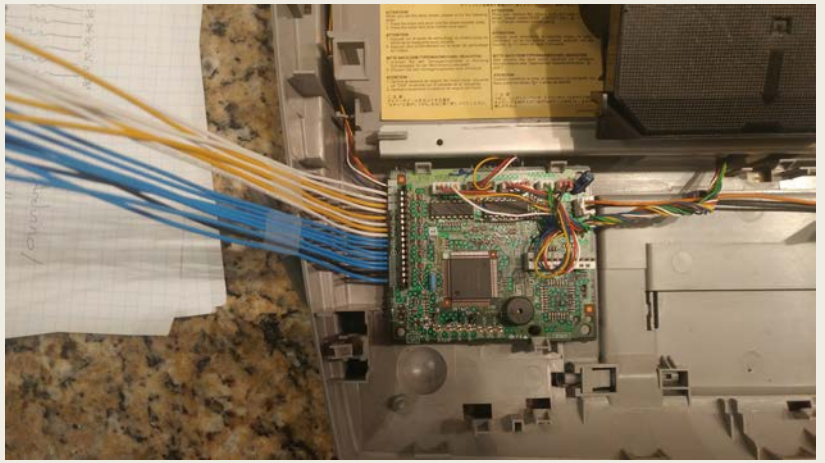
Right: Microcontroller and breadboarded transistor array.

This project was a recreational exercise in both hardware-microcontroller and microcontroller-computer interfaces. Images are broken down into lines of text by a Python script on a laptop, which then sends lines of ASCII via the serial-USB interface to the microcontroller. The microcontroller then emulates typewriter keypresses using the transistor array to switch the typewriter's keyboard matrix.

Left: The whole shebang, except for the laptop. A Rasberry pi and webcam might be added eventually to integrate the whole system inside of the typewriter enclosure.



Below: Interface between breadboard and the typewriter's keyboard matrix.



ULTIMATE DEATHTRAP

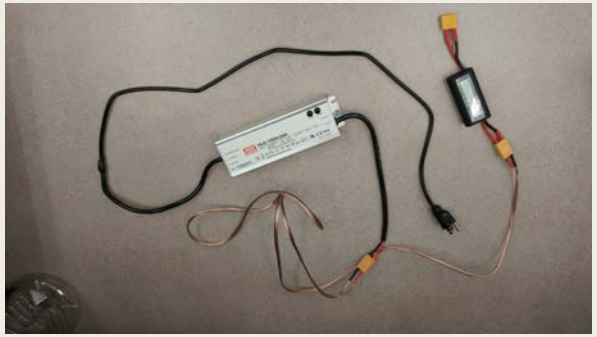
The danger scooter

80s childrens' kick-scooter converted into an electric 20mph monstrosity

Acknowledgements: Thanks to Hanna Lin and Dane Kouttron for help with sourcing ~90% of the parts and building

Project Dates: Feb. 2017 – Current

Ultimate Deathtrap V1 in all its glory.

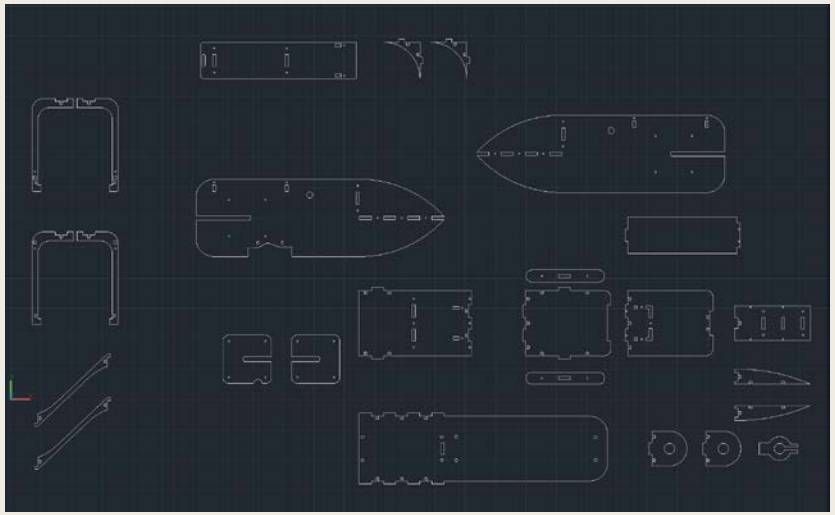


Above: Portable charger composed of a power monitor spliced onto a Meanwell LED streetlight power supply.

The original NiCd drill pack battery didn't do so well in the cold that is Minnesota, so they got replaced by A123 LiFePo4s.

In progress photo. Getting the 3000W hub motor to fit onto tiny scooter forks was an interesting puzzle.

Believe it or not, I ride this horrible thing to school. It has a top speed of about 20mph and a 16 mile range. Not pictured are recent improvements, including a speedometer and head/tail lights. Planned improvements include a less terrifyingly bendy chassis and perhaps some better brakes.



CAD drawings of a new chassis made hopefully of ¼" 6061 Aluminum.