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Quantifying HIV-1 Viral Load with Fluorescence Correlation Spectroscopy

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Authors

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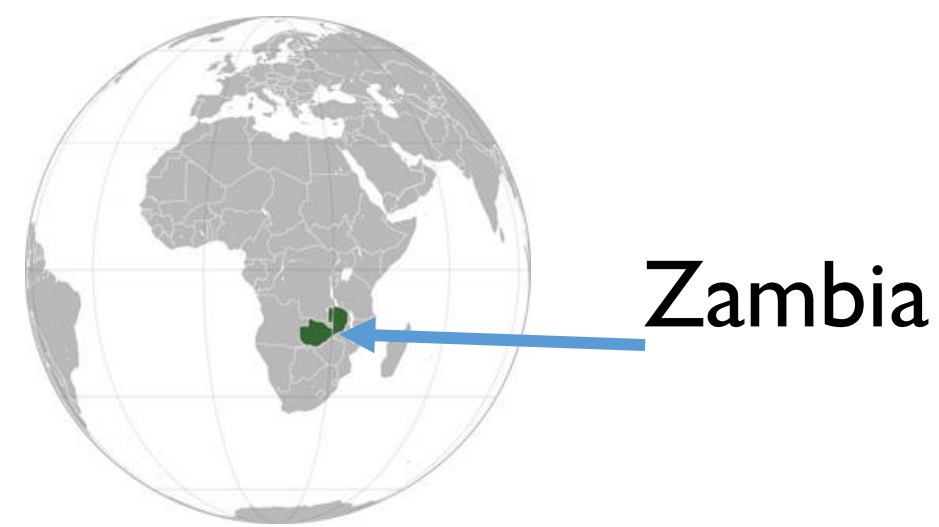
Quantifying HIV-1 Viral Load with Fluorescence Correlation Spectroscopy

Jeffrey Gao, Nathan Cordell, Castine Donoff, & Al Mokris

THE NEED

HIV diagnosis and viral load monitoring in Zambia is limited to clinics with lab settings, and difficult to access for many people in rural areas. The Macha Hospital in Zambia has partnered with us as we design an HIV viral load device.

Macha Mission Hospital



<https://eyecarefoundation.eu/projects/zambiamacha-eye-care-department/>

EXISTING DEVICE



<https://newfscientifc.com/cephid-genexpert-w-18480698/>

- Needs lab setting
- ~\$17,000/device
- ~ \$10/test
- < 1 hour
- ~30 viruses/mL

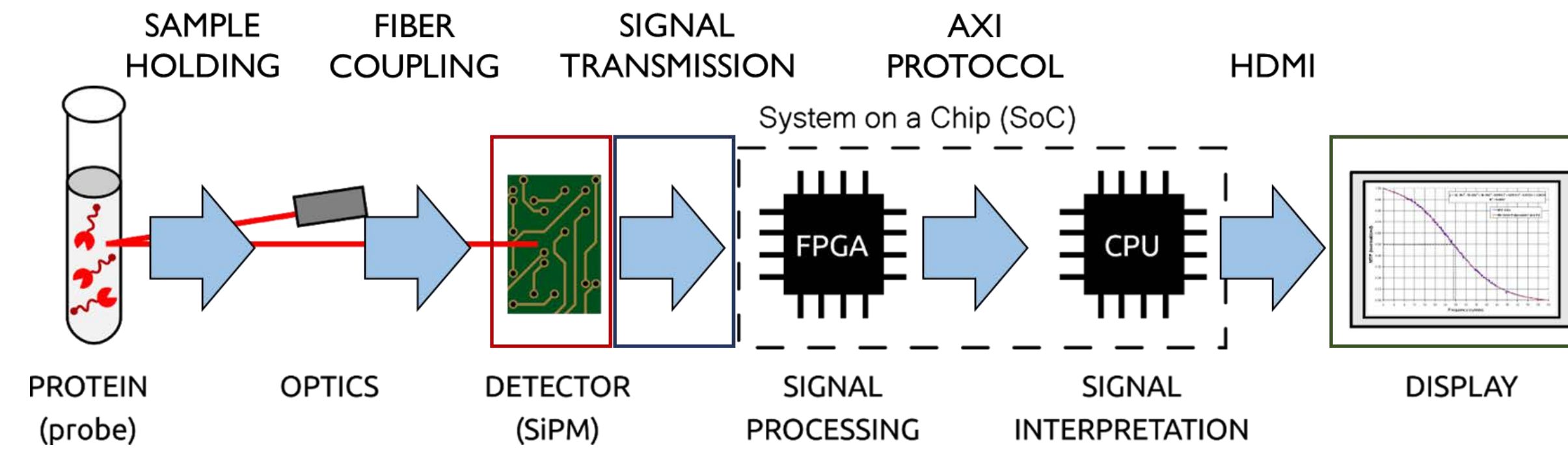
OUR DEVICE



- Targets:**
- Portable (10" x 8" x 3")
 - ~ \$1500/device
 - ~ \$10/test
 - <10 minutes
 - ~1000 viruses/mL

DIAGNOSTIC STRATEGY

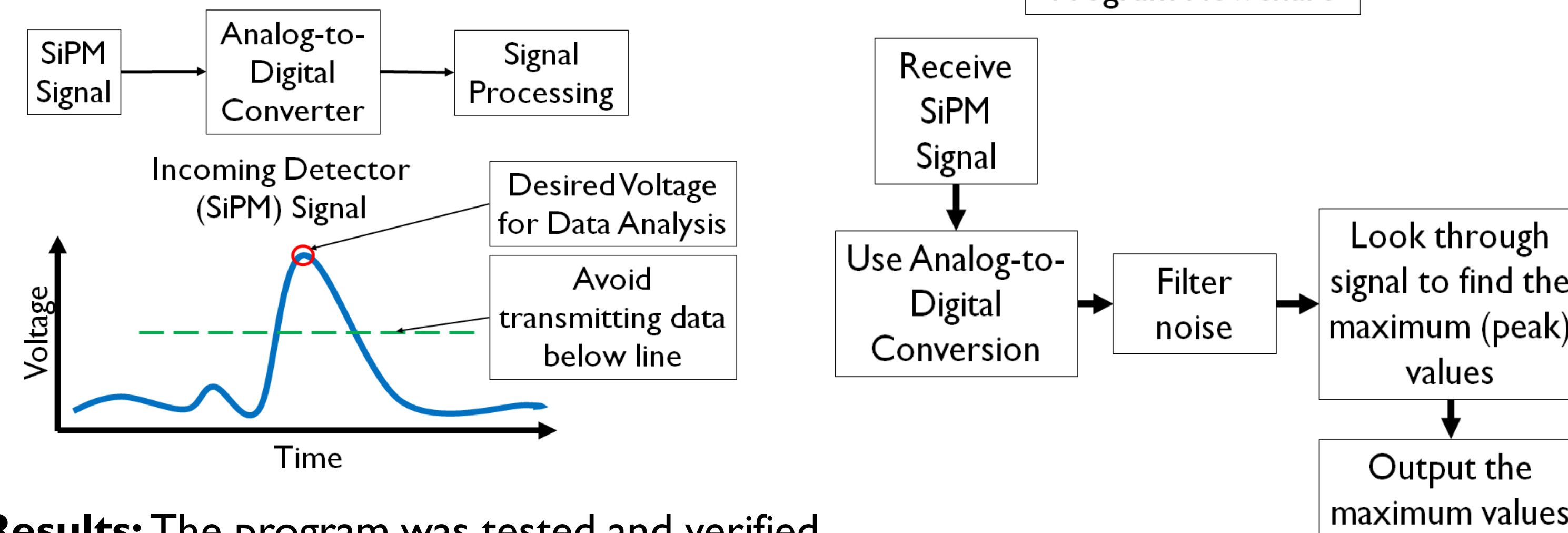
The following Diagnostic Strategy has been proposed for HIV viral load determination:



THE NEXT STEP: Integration of completed modules to test a full prototype system.

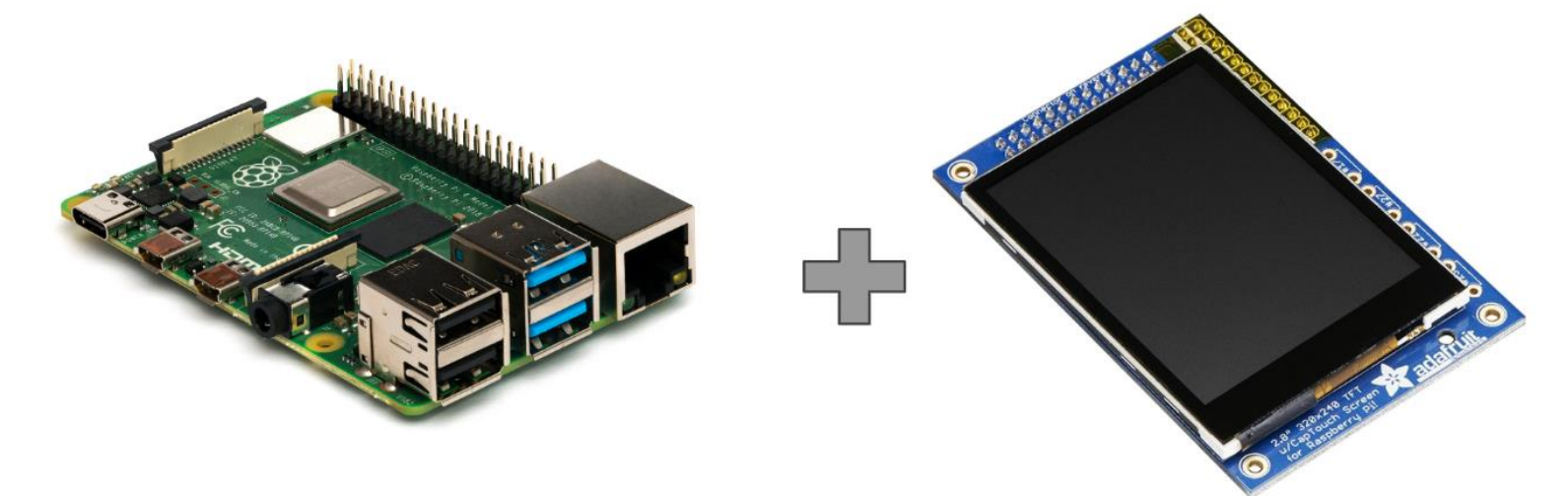
SIGNAL TRANSMISSION

Designing and testing a program to transmit data from the detector circuit to the FPGA for signal processing and interpretation.



Results: The program was tested and verified.
Future Work: Program will be used in prototyping.

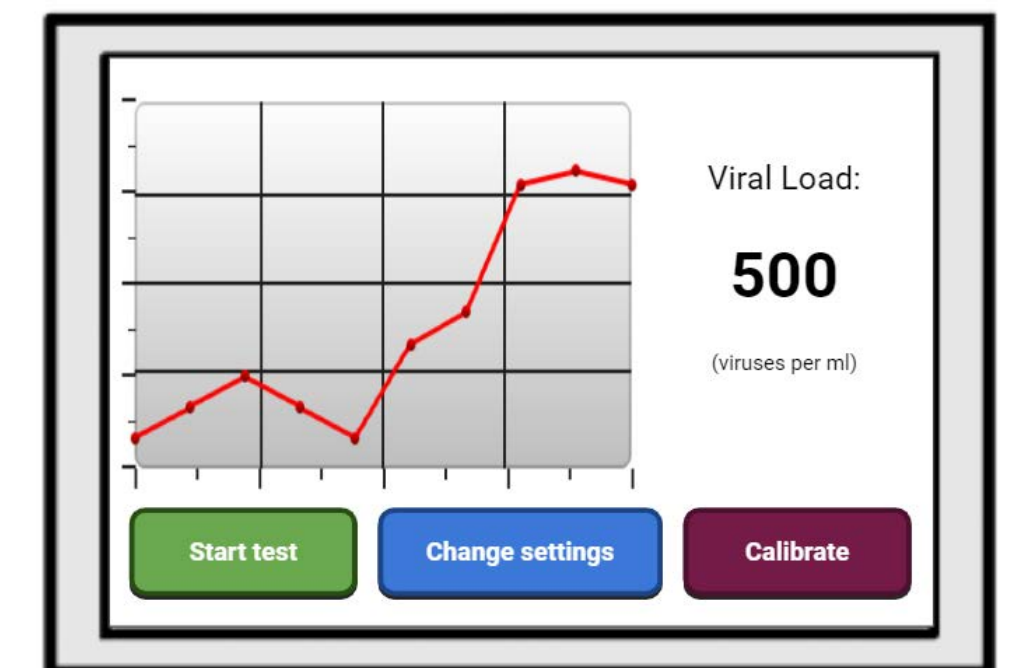
USER INTERFACE/DISPLAY



Raspberry Pi

Adafruit Touchscreen

Goal: To connect the Raspberry Pi & Adafruit Touchscreen, and design code using a graphical user interface (GUI) that presents client with generic autocorrelation results



Goal GUI Button

#Code written in Python3.7.3 by Castine Donoff

```
#Each widget added after app
from guizero import App, Text, PushButton, TextBox
```

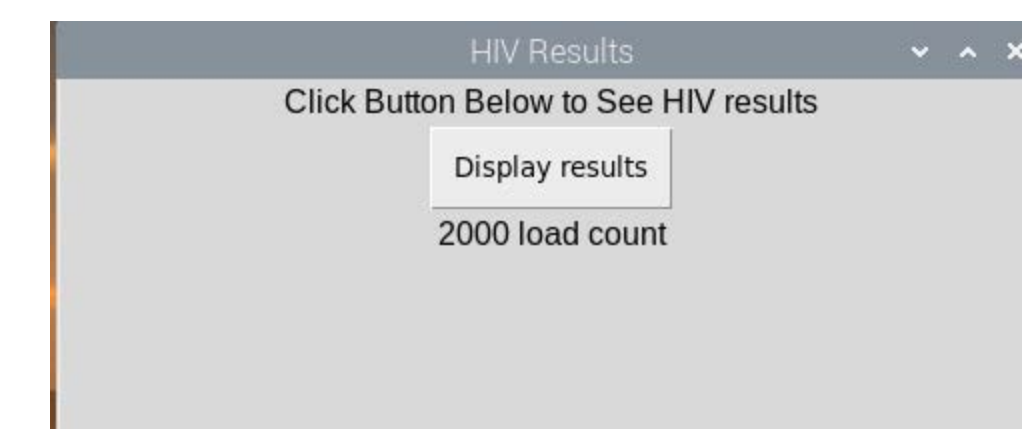
```
#Command push for push button
def display_results():
    load_count = Text(app, text = "2000 load count")
    results.value = load_count.value
```

```
app = App(title = "HIV Results")
```

```
#Message saying what to do
welcome_message = Text(app, text = "Click Button Below to See HIV results")
```

```
#Message on push button
update_text = PushButton(app, command=display_results, text="Display results")
app.display()
```

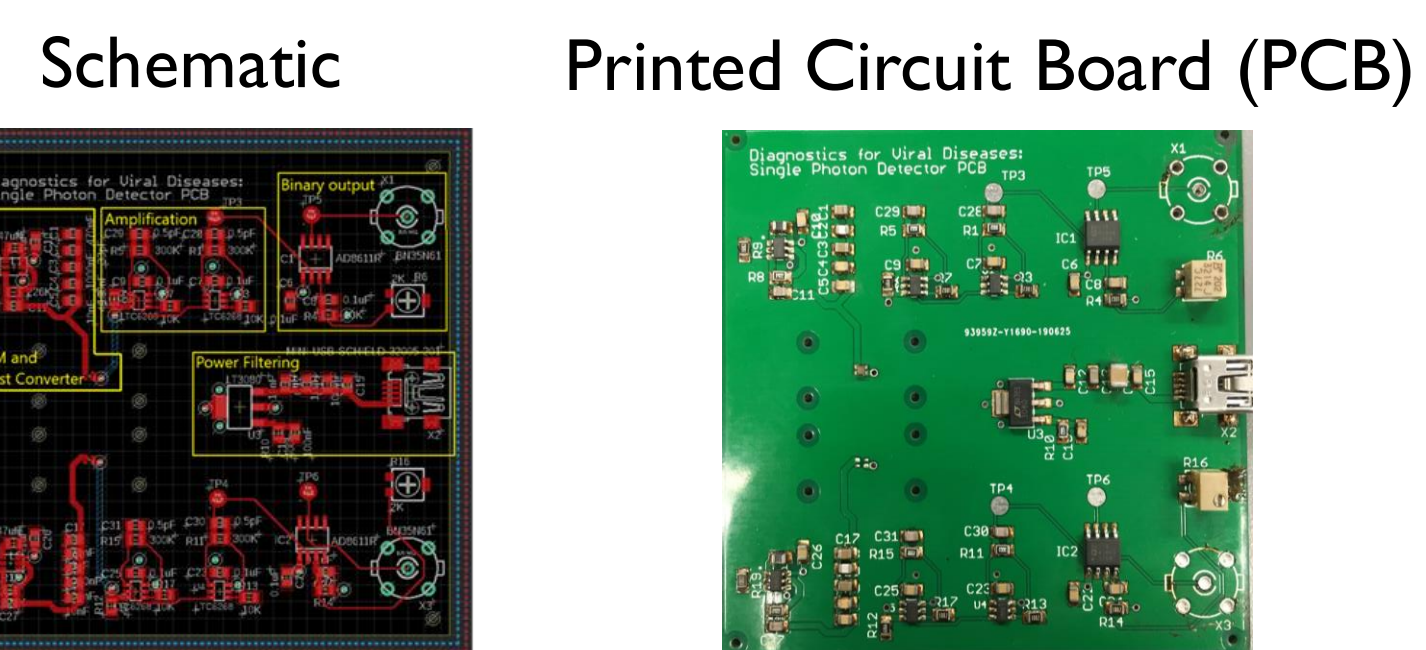
GUI Design Code Written in Python)



Current GUI Button

- Moving Forward:**
- Improve GUI usability and aesthetic
 - Alter code to run immediately following the powering up of the Raspberry Pi
 - Display autocorrelation results directly from FPGA system

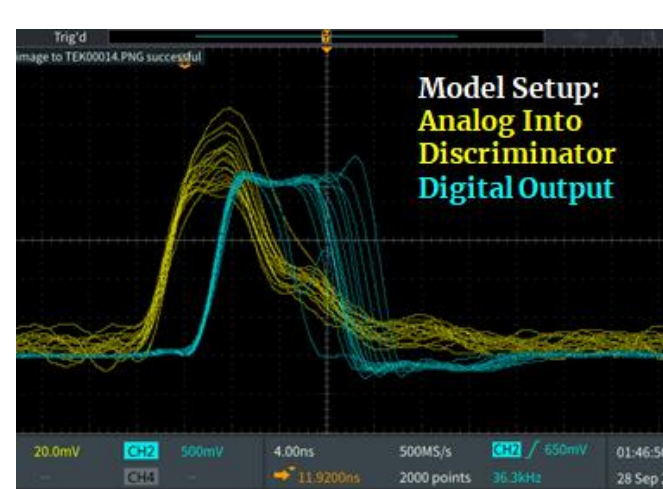
PCB Design



DETECTOR CIRCUITRY

- **Conclusion:** Switching to a modular detector design resulted in desired silicon photomultiplier light-to-electronic signal behavior.
- **Moving Forward:** Will continue to improve circuit design while characterizing observed output.

OUTPUT COMPARISONS

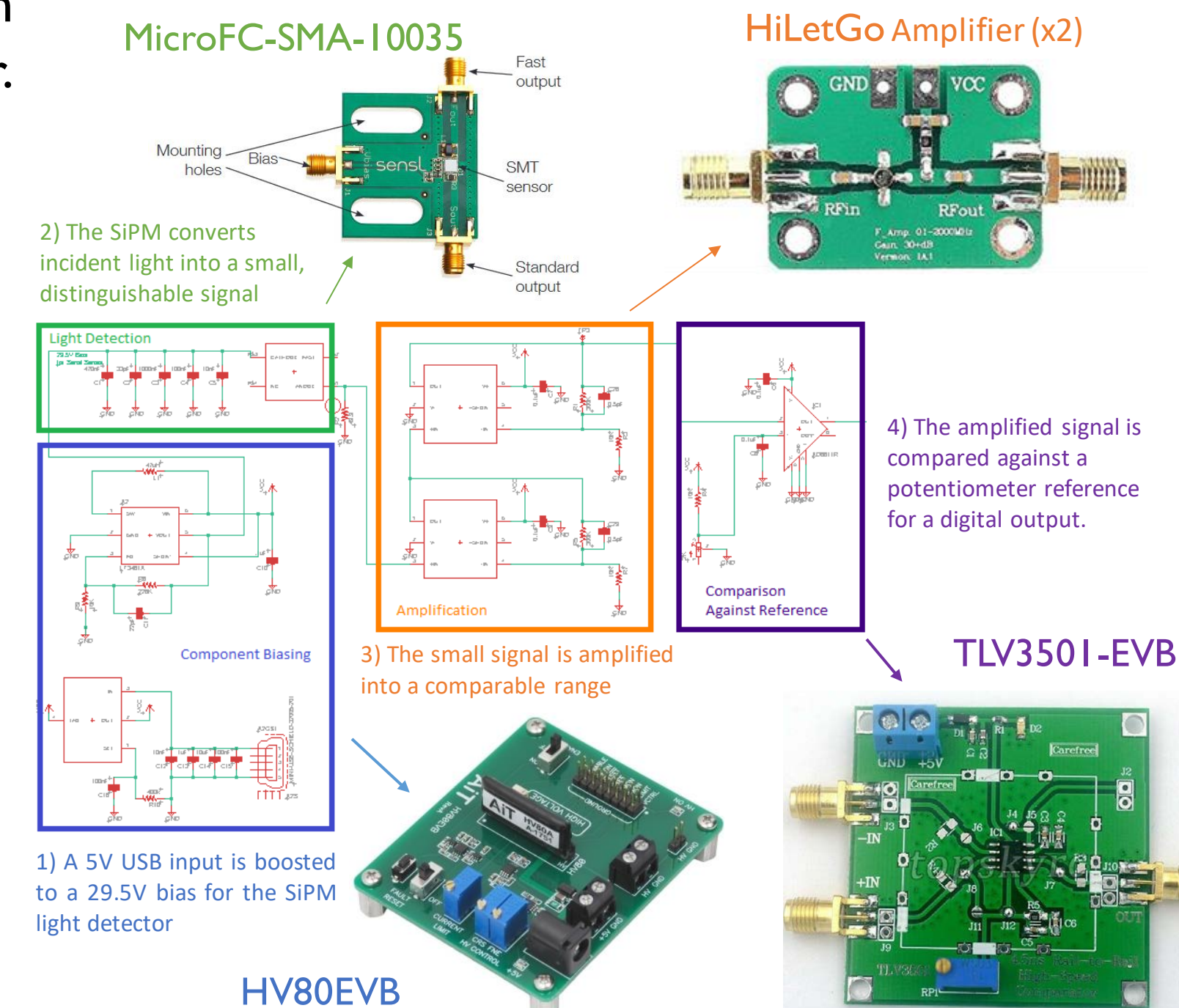


Expected Output

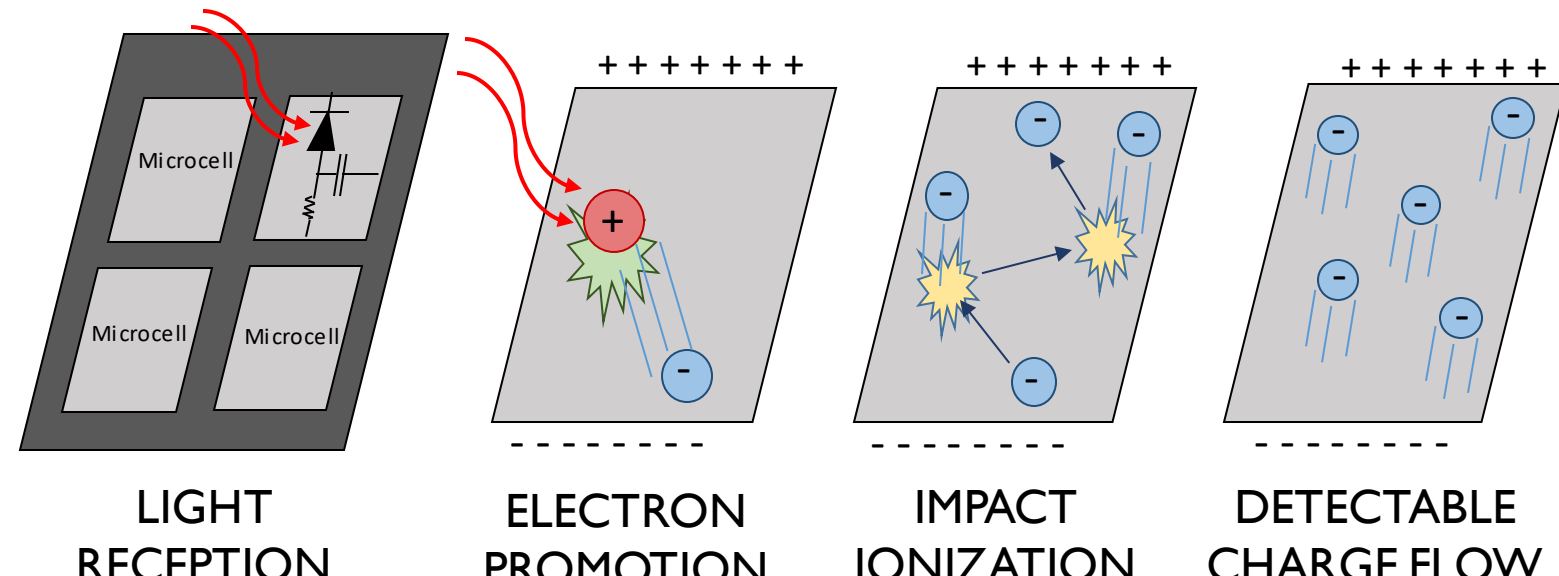
PCB Design Output

Modular Design Output

Modular Design



SILICON PHOTOMULTIPLIER: SIGNAL TRANSFORMATION



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Members: Alicia Decker, Morris Taylor, Nathan Chan, Brant Meier, Timothy Lee, Jessica Paulus, Al Mokris, Ben Curtz, Joshua Keong

