

AN INEXPENSIVE AND SIMPLE OPTICAL SENSOR SYSTEM FOR LAB-BASED RAPID TESTING

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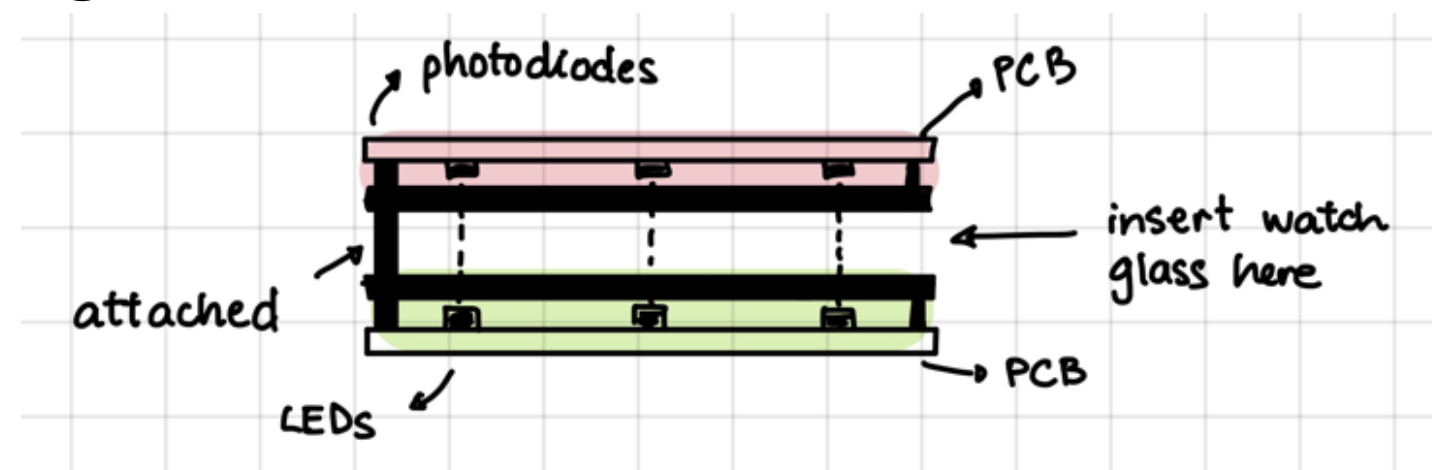
ABSTRACT

With the uncertainty and high-risk nature of infectious diseases, rapid testing is needed to protect the community from an epidemic. A new antigen testing method using **Gold Nano-Particles (AuNP)** is used to detect viral concentration based on light absorbance of the samples. A system consisting of light emitting diodes (LEDs) and photodiodes has been used as an optoelectronic sensing device for single samples. This research focuses on studying the implementation of LED-photodiode based electronic readout systems towards small yet rapid and accurate testing of an array of samples.

PHOTODIODE – LED SET UP

Photodiodes convert light into a small voltage where the current, which can be measured, is used as a parameter to determine the relative concentration of the samples.

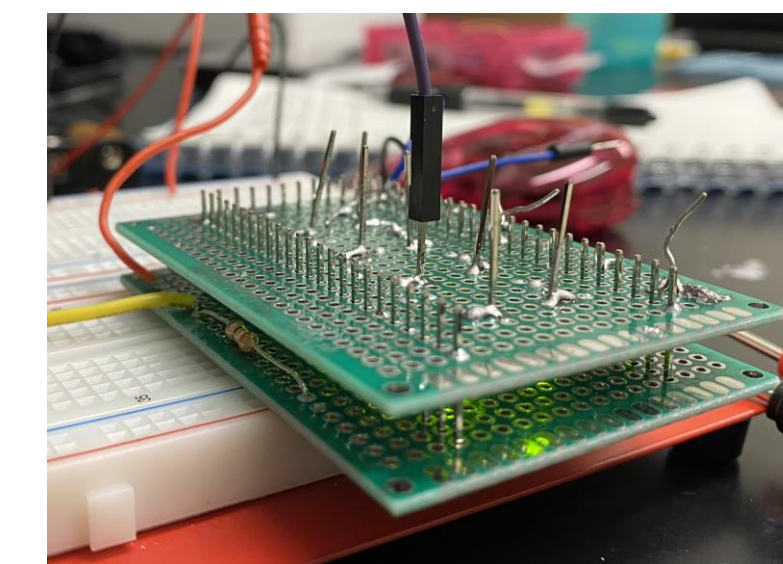
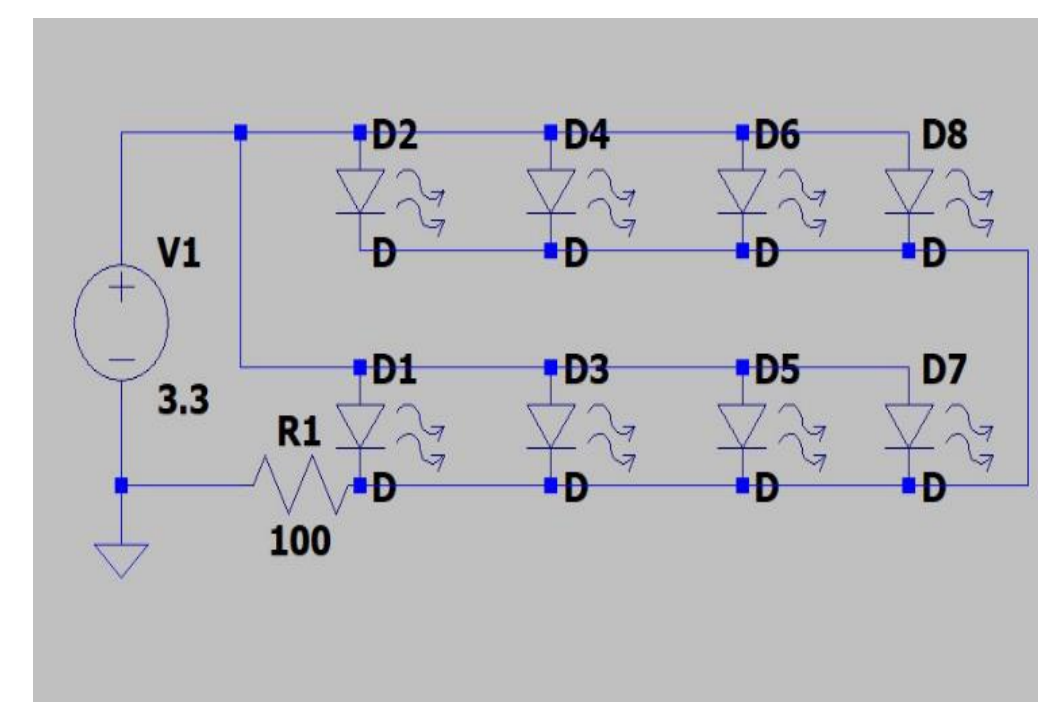
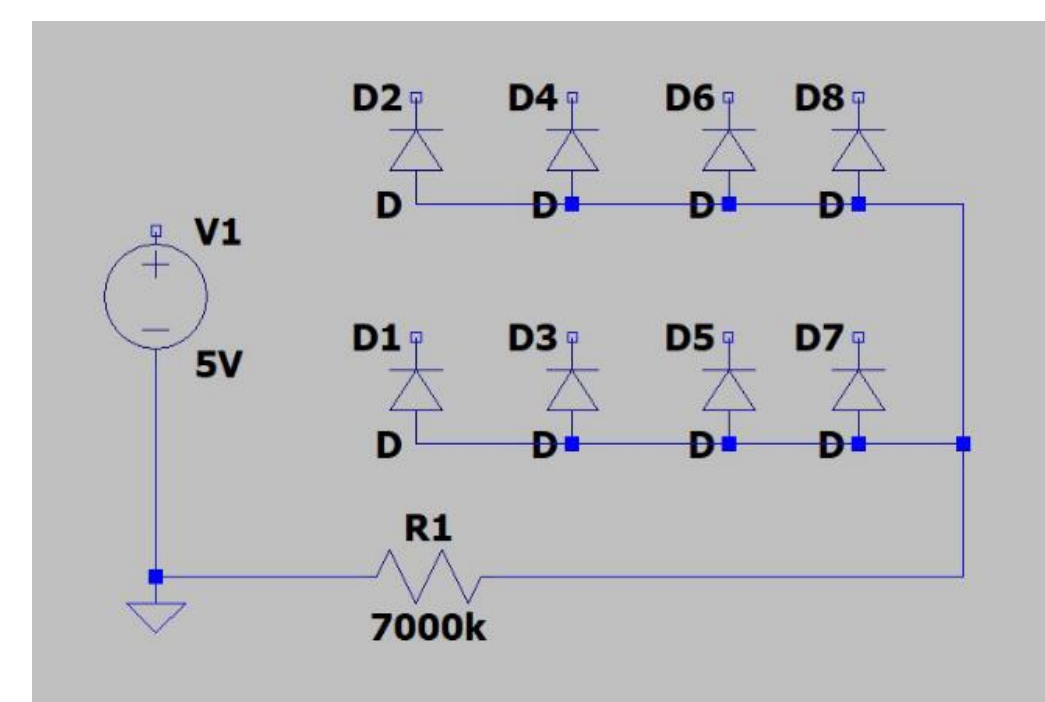
Design idea:



Device's Components:

- 8 photodiodes - 8 LEDs
- 7MO and 100 O resistors
- An Arduino board to power the device and collect read-out voltage
- LCD display to show the measurement.

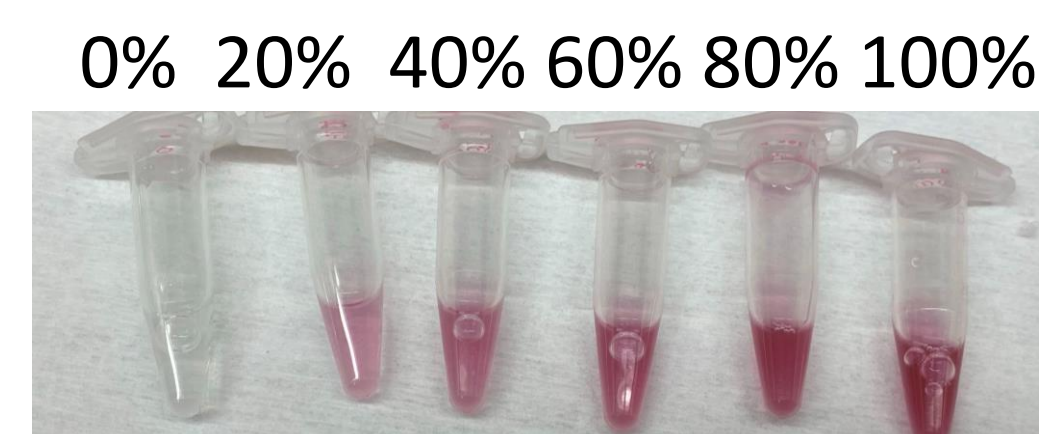
DEVICE DESIGN



DEVICE PERFORMANCE

Sample Preparation:

- Dilute concentrated AuNP (0.33nM) solution with AuNP buffer at different ratios.
- The higher the concentration of AuNP, the darker the solution is.
- 20 μ L samples were put on a watch glass with a PDMS layer to hold the sample in place.

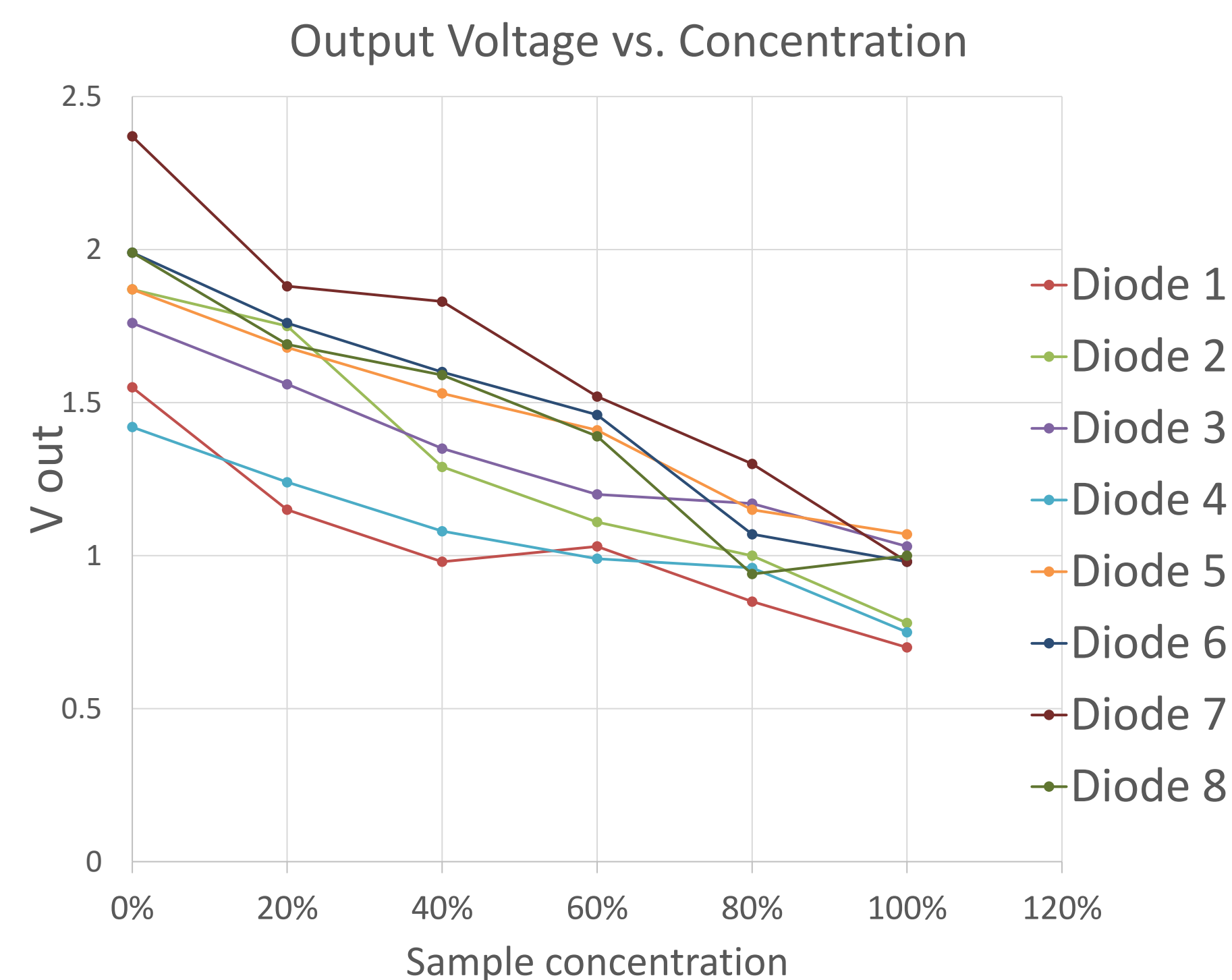


Expectation:

At higher AuNP concentration, the output voltage should be lower than the output voltage at lower concentration.

Result:

The output voltage has a downward trend which aligns with our expectation. However, there are also some data points that do not align.



CONCLUSION

- Sample height and bubble can affect the read-out value. To minimize this, at least 20 μ L of sample should be used.
- Photodiode – sample – LED misalignment will change the read-out value. 3-D printed cases for the device and sample holder will be sufficient to solve this issue.
- Overall, this device has great potential to be used in lab-base testing due to its capability for obtaining an instant response.
- The optical sensing system of photodiode–LED is very affordable and can be integrated into different designs depending on the user's requirements.



NEXT STEP

- The output voltage can be amplified to increase the device's dynamic range.
- Light distortion can cause the result to elevate. Therefore, the device can be implemented to block out environmental light and reduce light reflection from LEDs.

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