9TH International Electronic Conference on Sensors and Applications

Lassonde School of Engineering at York University
Department of Mechanical Engineering

Arduino-Based Sensing Platform for Rapid, Low-Cost, and High Sensitivity Detection and Quantification of Analytes in Fluidic Samples

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Introduction

- Lateral Flow Assays are inexpensive tests used to qualify the presence or absence of analyte in a fluid

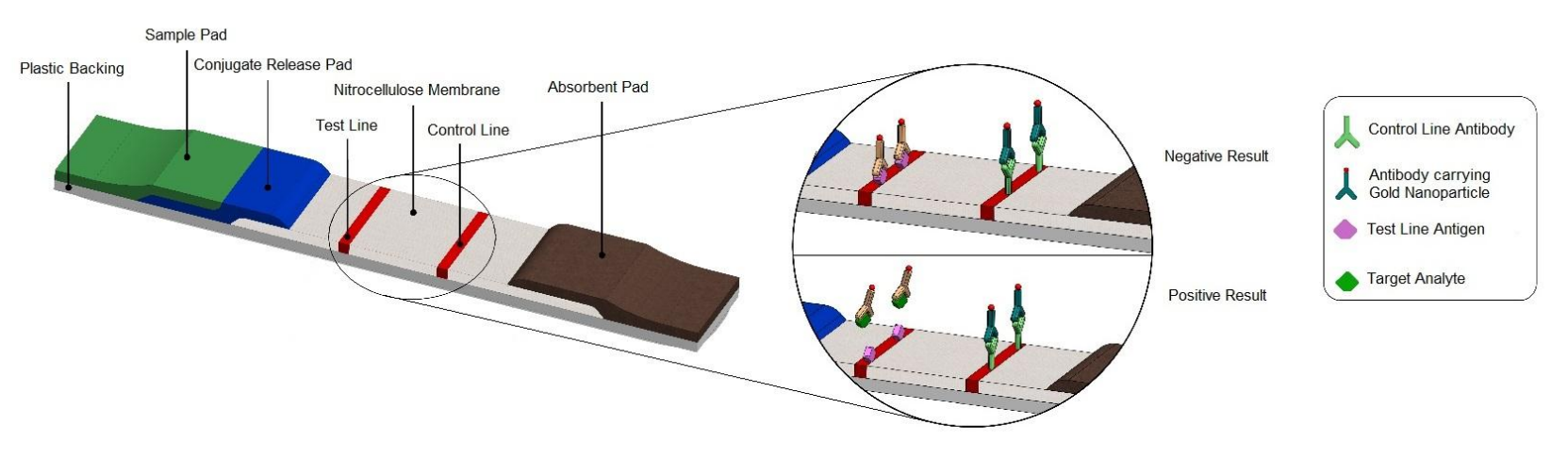
- LFAs are used in many applications such as food and water safety testing, with a global market size of $12.6 Billion by 2026*

- Interpreted with colorimetric methods, visually or using machine vision

Photo by: Greenvalley Pictures

*Lateral Flow Assays Market by Application - Global Forecast to (2022 - 2026). Available online: https://www.marketsandmarkets.com/Market-Reports/lateral-flow-assay-market-167205133.html

Working Principles – Lateral Flow Assay



Lateral Flow Assay Limitations

- LFAs are limited by their relatively low Limit of Detection and inability to quantify results

- We recently showed that LFA detection performance can be dramatically improved by imaging the photo-thermal responses of LFA GNPs with infrared cameras*

- This capstone project recreated the device using an inexpensive infrared sensor in an effort to eventually make this device accessible to the public as an end-user solution

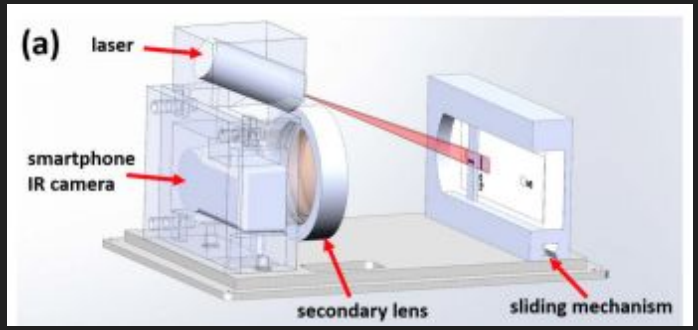
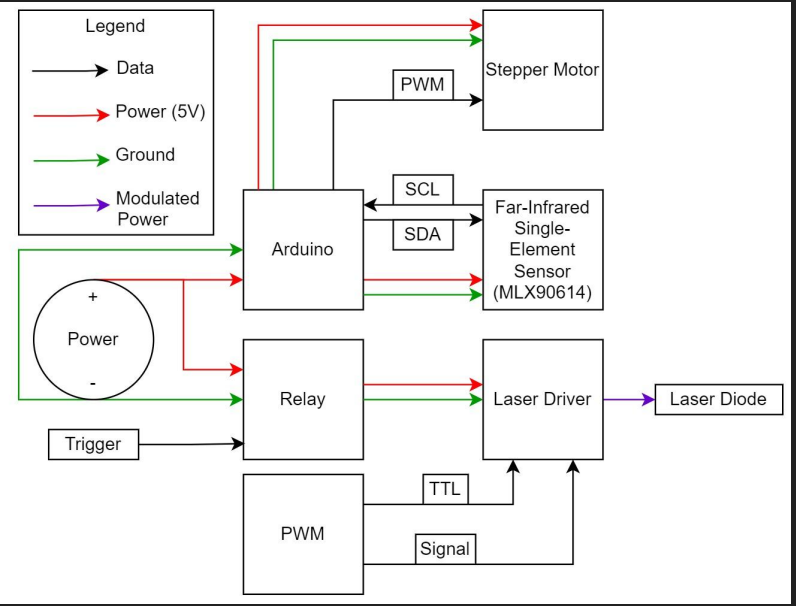
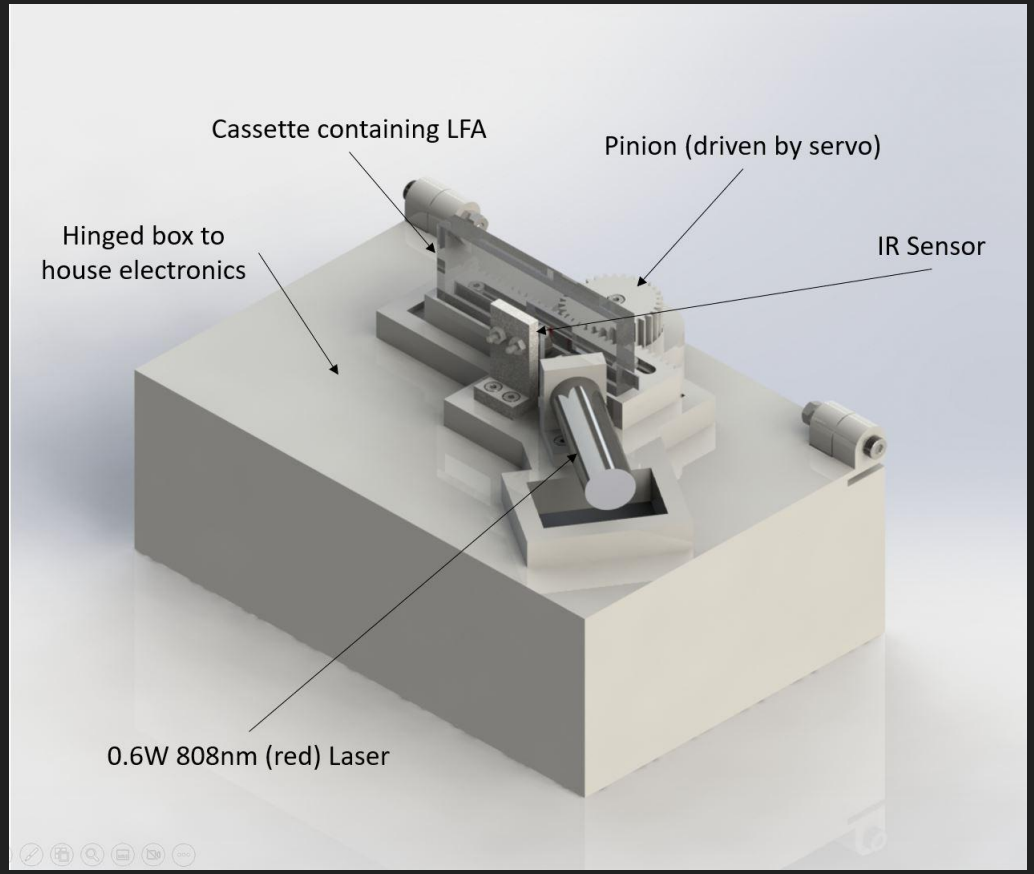


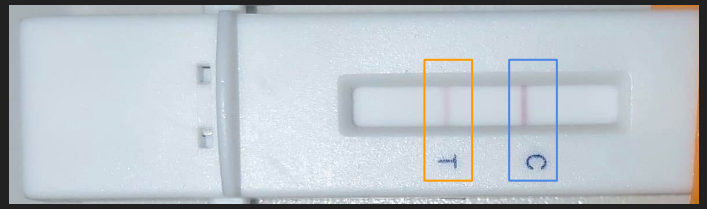
***Image and findings from:** Handheld Thermo-Photonic Device for Rapid, Low-Cost, and On-Site Detection and Quantification of Anti-SARS-CoV-2 Antibody By Thapa, D.; Samadi, N.; Tabatabaei, N

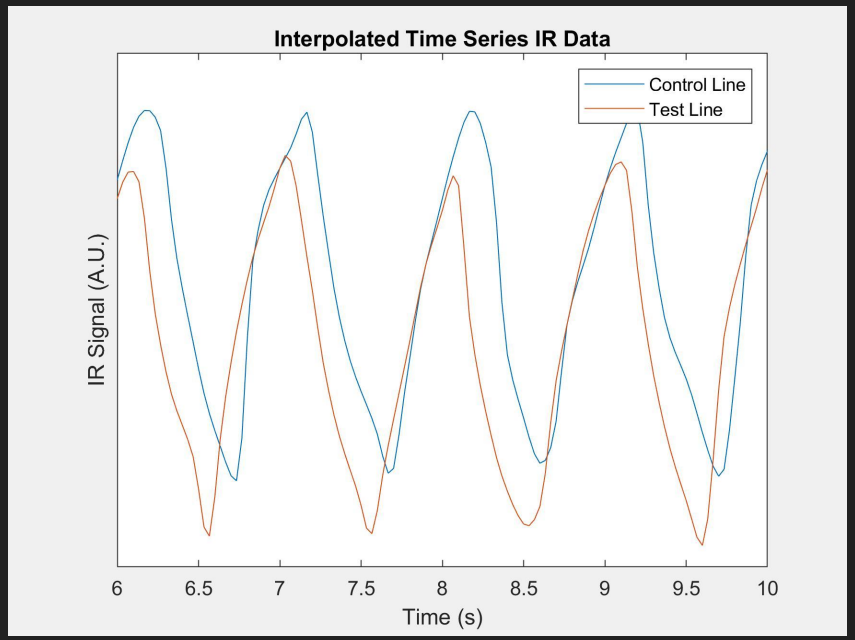
Design

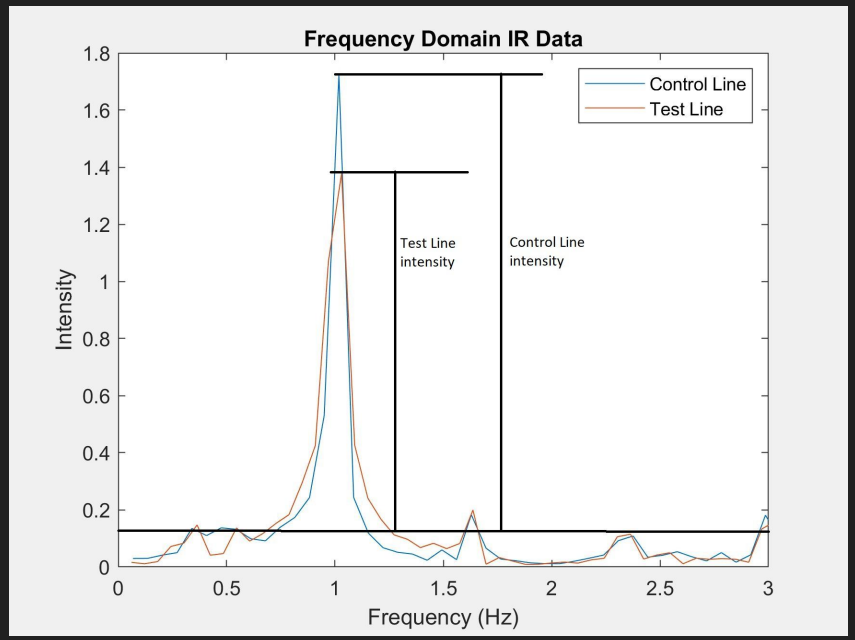

Legend
Data
Power (5V)
Ground
Modulated Power
Stepper Motor
PWM
SCL
SDA
Arduino
Far-Infrared Single-Element Sensor (MLX90614)
+
Power
-
Relay
Laser Driver
Laser Diode
Trigger
PWM
TTL
Signal


Cassette containing LFA
Pinion (driven by servo)
Hinged box to house electronics
IR Sensor
0.6W 808nm (red) Laser

Working Principles - Lock-in Demodulation

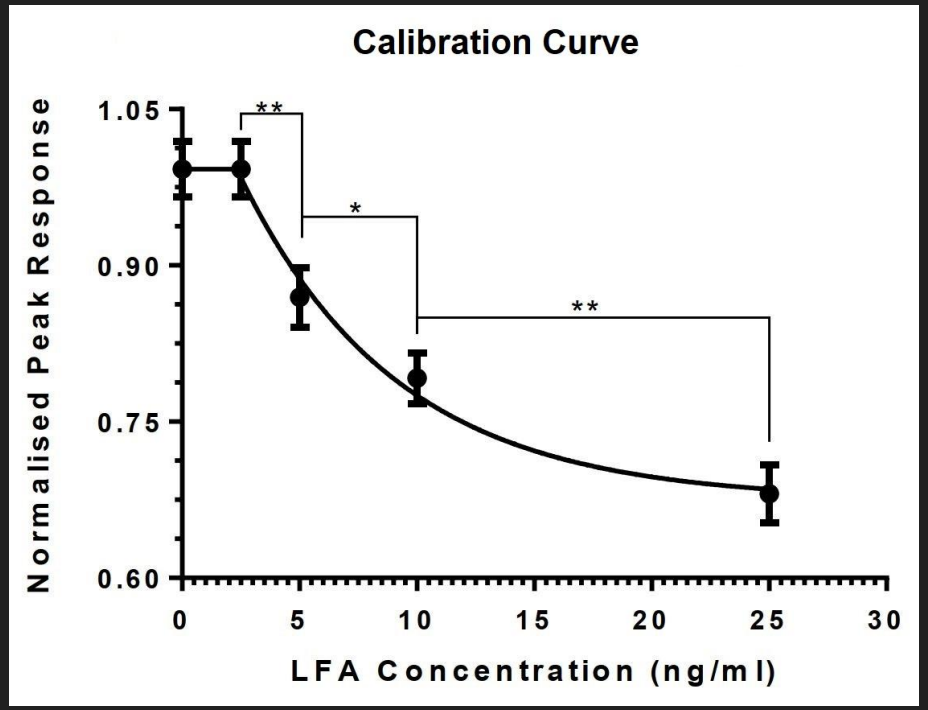






Results

- There was a monotonic change in response with analyte concentration
- Readings at different concentrations were significantly different, allowing for quantification
- Limit of Detection was increased by almost an order of magnitude (25ng/mL to 5ng/mL)



The sliding mechanism is most prone to failure and will be replaced in favour of two sensors in the future

This was a feasibility study, more rigorous tests will be performed as the technology continues to develop

I continue to improve this device and technology as a part of my MSc thesis

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Thank you

To the rest of the capstone team and our supervisor Professor Nima Tabatabaei

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