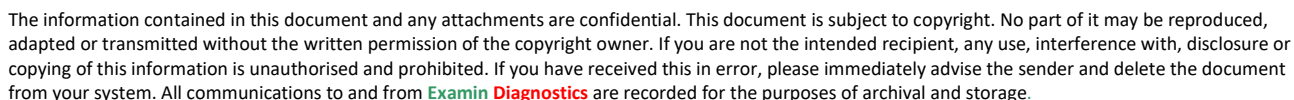
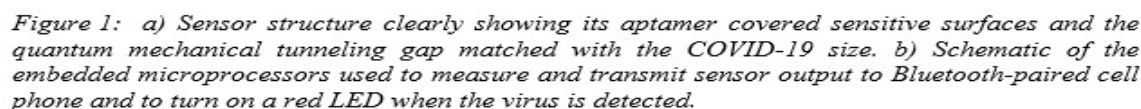
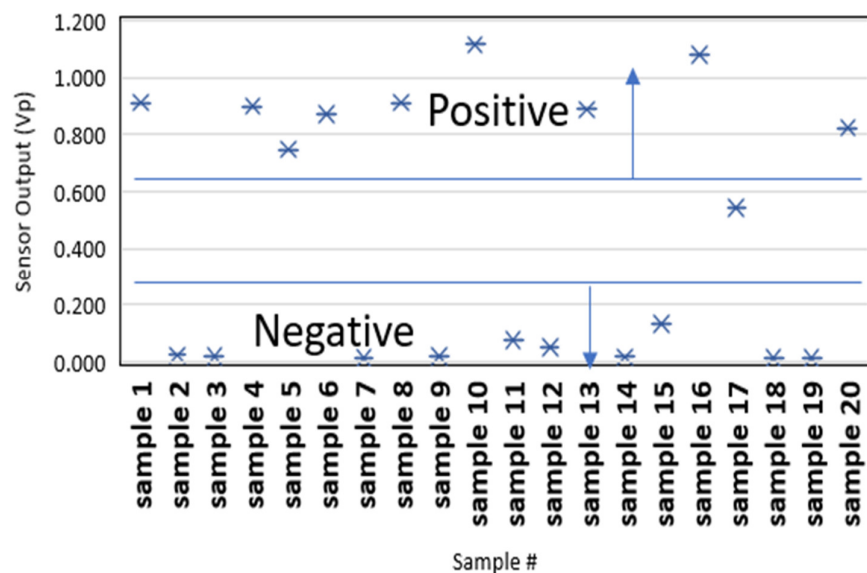


During the last 12 months many POC systems are developed and reported for COVID-19. These techniques can be broadly divided to three categories based on their target molecules: 1) sensors that detect the viral RNA/DNA, 2) sensors based on detecting the virus antigens, and 3) sensors that detect antibodies produced in the body in response to the viral infection.

The antigen test detects proteins on or within the COVID-19. The antibody test detects antibodies produced by the body in response to the infection. While the antigen tests can be done earlier in the infection stage, it takes a while (2-3 weeks) for the body to produce antibodies. These tests are fast and quite accurate but require pre-processing of the viral particles and bodily fluids (lysing and filtering).

Our POC sensor detects the whole virus from air, surfaces, water and in the body fluids such as saliva. It consists of a) a sensitive surface that is coated with aptamers that bind with the virus (Fig. 1a), b) a matched electrode gap device that in the presence of the virus its capacitance changes considerably (Fig. 1a) from 0.5 pF to 10s of pF at 500 kHz, and c) an electronic measurement circuit and embedded microprocessor that detects the device's electrical impedance and makes decision regarding the presence of the virus (Fig. 1b).





The salient features of our POC sensor that set it apart from the other POC sensors is that it detects the whole virus enabling it to be very fast (~ 1 min.) without requiring analytes and technicians to operate. Our sensor is a do-it-yourself (DIY) POC device with high accuracy. Currently, the aptamers we have employed in our sensors are capable of binding with the S1 and S2 spiking proteins of the variant COVID-19 viruses. We will use modified aptamers when and if variations become too large for the existing aptamers to efficiently bind with them.

Summary of data from testing quantum tunnelling sensors developed by UTAH University.

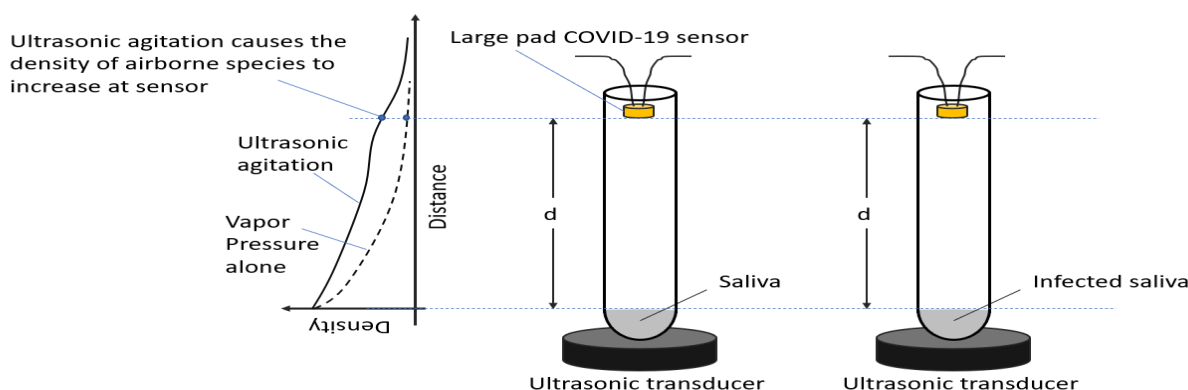
We have done 175 sperate tests and gathered considerable data readings over more than 12 months whilst improving and developing sensors from the original linear unit to the new bullseye unit.

Testing modality for Airborne virus detection using the multi sensor bullseye devices that each contain 300 sensors.

The instrument produces two different sets of measurements called parallel capacitance (C_p), parallel resistance (R_p), series capacitance (R_s), and series capacitance (C_s):

Experimental Setup

- To find out if the large pad devices are capable of detecting airborne viruses, the experimental setup shown below was used.

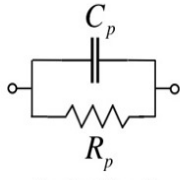


- The sensors were kept inside the test tube from 60 s to up to 5 min with ultrasound “on”.

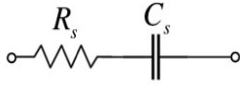
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- We then measured their impedance. The instrument produces two different sets of measurements called parallel capacitance (C_p), parallel resistance (R_p), series capacitance (R_s), and series capacitance (C_s):

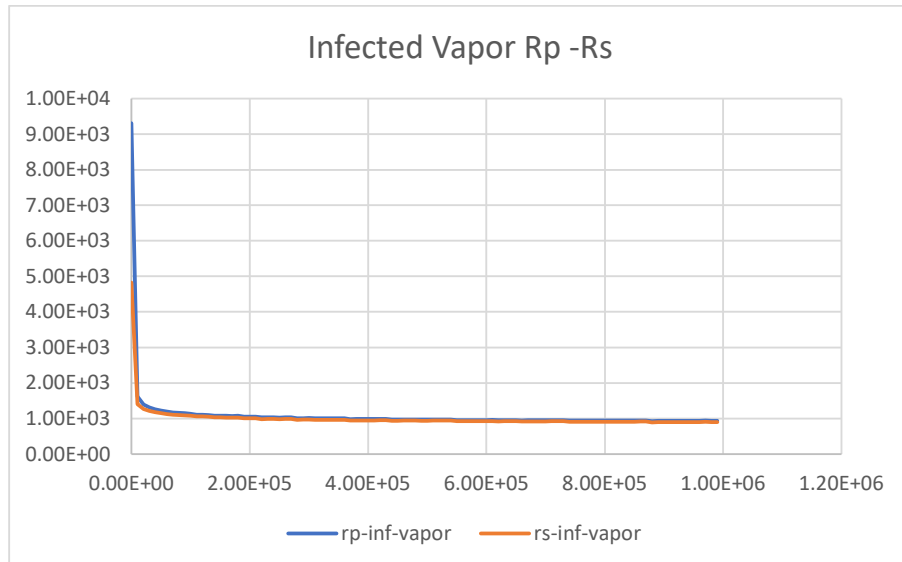
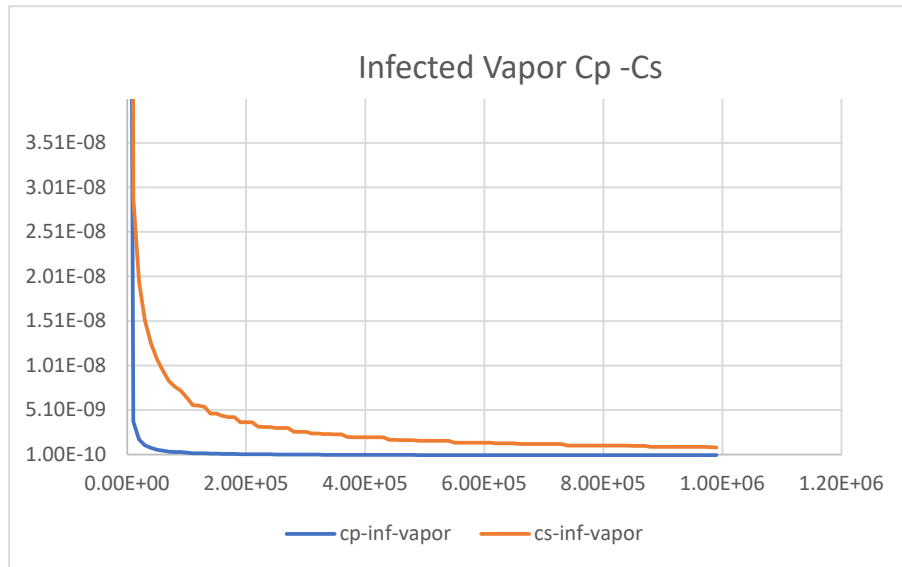
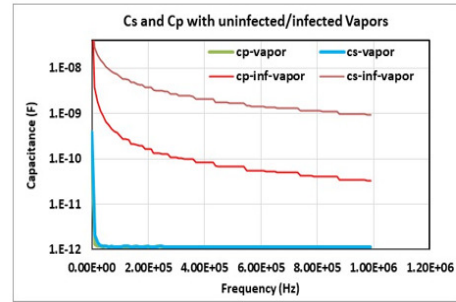
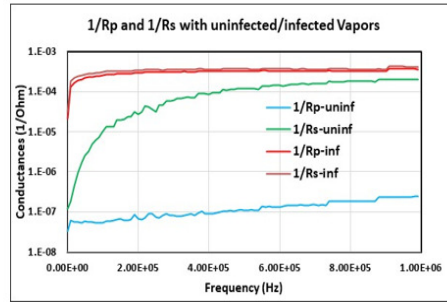
Parallel Circuit



Series Circuit



The infected and uninfected vapors clearly induce completely different responses (red curves)



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Compared to all other POC testing devices that require lysing of the virus (RNA/DNA/antigen) or antibodies, our POC sensor directly detects the whole virus without lysing and without requiring body response molecules. Consequently, our POC sensor is very fast (1 min. or less response time) and does not require analytes and consumables.

It is important to emphasize that our sensor detects the whole virus, and its output is determined by a) the virus size (~125 nm), b) binding affinity with the sensor aptamers (designed to bind with S1, S2 surface spiking proteins of COVID-19) and c) by the electrical properties of the COVID-19 in the sensor's sensitive tunnelling gap. Dust particles and other nanoparticles such as exosomes that exist in the saliva and breath have different diameters, do not bind with the sensor aptamers, and have completely different electrical properties.

Sample of data over 40,000 separate readouts were documented from the 175 separate tests over an 18-month period, using the readouts from the frequencies parallel capacitance (C_p), parallel resistance (R_p), series capacitance (R_s), and series capacitance (C_s): to determine virus positive or negative.

Sample of outputs:

Frequency	cp-inf-vapor	rp-inf-vapor	cs-inf-vapor	rs-inf-vapor
1.00E+02	1.66E-07	9.31E+03	3.36E-07	4.83E+03
1.01E+04	3.81E-09	1.61E+03	2.89E-08	1.40E+03
2.01E+04	1.81E-09	1.40E+03	1.95E-08	1.27E+03
3.01E+04	1.16E-09	1.31E+03	1.52E-08	1.21E+03
4.01E+04	8.44E-10	1.26E+03	1.26E-08	1.18E+03
5.01E+04	6.62E-10	1.23E+03	1.08E-08	1.15E+03
6.01E+04	5.45E-10	1.20E+03	9.52E-09	1.13E+03
7.01E+04	4.53E-10	1.17E+03	8.38E-09	1.11E+03
8.01E+04	4.02E-10	1.16E+03	7.71E-09	1.10E+03
9.01E+04	3.74E-10	1.15E+03	7.31E-09	1.09E+03
1.00E+05	3.20E-10	1.13E+03	6.49E-09	1.08E+03
1.10E+05	2.66E-10	1.11E+03	5.64E-09	1.06E+03
1.20E+05	2.66E-10	1.11E+03	5.63E-09	1.06E+03
1.30E+05	2.55E-10	1.11E+03	5.45E-09	1.05E+03
1.40E+05	2.13E-10	1.08E+03	4.72E-09	1.03E+03
1.50E+05	2.13E-10	1.08E+03	4.71E-09	1.03E+03
1.60E+05	2.00E-10	1.08E+03	4.47E-09	1.03E+03
1.70E+05	1.92E-10	1.07E+03	4.32E-09	1.03E+03
1.80E+05	1.92E-10	1.07E+03	4.31E-09	1.03E+03
1.90E+05	1.60E-10	1.05E+03	3.73E-09	1.01E+03
2.00E+05	1.61E-10	1.05E+03	3.73E-09	1.01E+03
2.10E+05	1.60E-10	1.05E+03	3.72E-09	1.01E+03
2.20E+05	1.34E-10	1.03E+03	3.22E-09	9.87E+02
2.30E+05	1.34E-10	1.03E+03	3.21E-09	9.89E+02
2.40E+05	1.34E-10	1.03E+03	3.20E-09	9.90E+02
2.50E+05	1.29E-10	1.03E+03	3.09E-09	9.87E+02
2.60E+05	1.29E-10	1.03E+03	3.08E-09	9.89E+02
2.70E+05	1.29E-10	1.03E+03	3.07E-09	9.90E+02