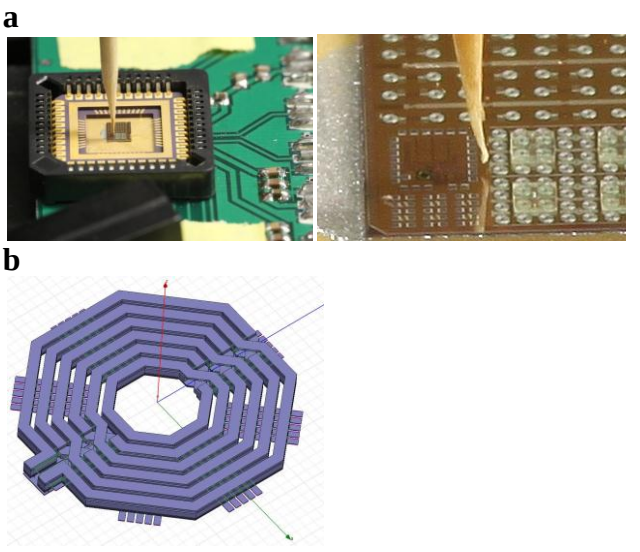

Fig. S1 (a) To test the vertical sensitivity of the sensors to beads, a toothpick containing beads on the tip was moved at varying positions above the sensor using a micrometer. As a control, a toothpick without beads was measured at the same heights. (b) Additionally, an electromagnetic simulation was used to determine the vertical sensitivity of the sensor to magnetic beads. (c) The results of the simulation and experiment reveal a 10%, 50%, and 90% reduction in sensitivity at bead heights 3µm, 13µm, and 40µm above the sensor surface, respectively. (d) Only a fraction of the total sensing volume is used in the surface binding-based approach. Future designs could utilize the full sensor volume and expand the dynamic range of the sensor.

a

Conc. (nM)	Conc. (pg/mL)	Exp. Freq. Shift (kHz)	NC Freq. Shift (kHz)
10	5000	730	18
1	500	409	6
0.5	250	293	30
0.1	50	54	26

b

Conc. (pM)	Conc. (pg/mL)	Exp. Freq. Shift (kHz)	NC Freq. Shift (kHz)
150	2500	1080	74
60	1000	740	30
30	500	1250	-117
10	200	1020	68
6	100	630	0
2	40	220	-3
1	20	330	48

Fig. S2 Table of frequency-shift measurements versus frequency for (a) the DNA assay and (b) the immunoassay.

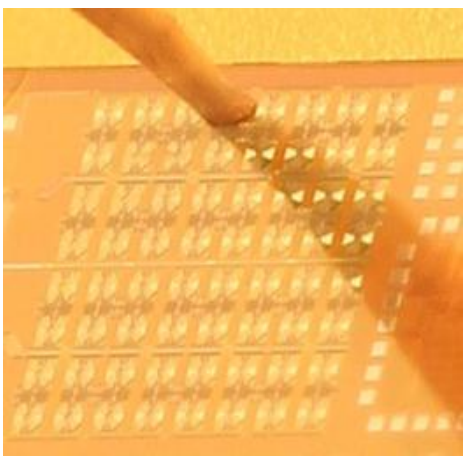

Fig. S3 In order to isolate the each cartridge's variability in quantifying beads, it is necessary to ensure each cartridge measures the same quantity of beads. A distribution of beads is fixed to the tip of a non-magnetic wooden probe using a synthetic polymer resin. The probe is visually aligned to a sensor on each cartridge and frequency shift measurements are obtained.