SUPPLEMENTARY MATERIAL

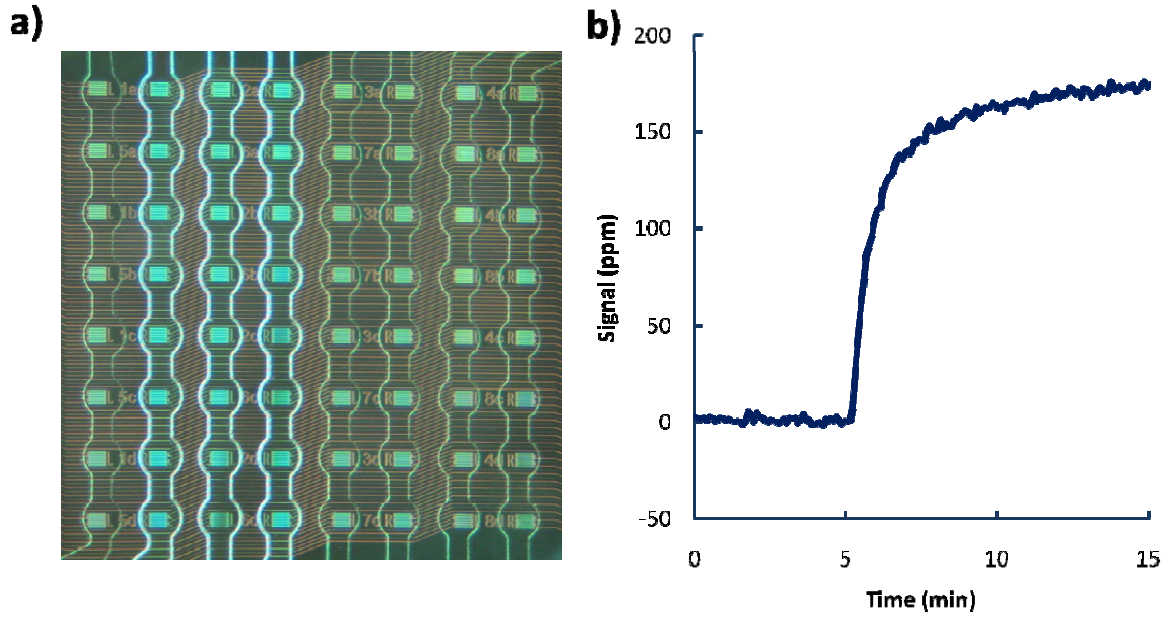

Fig.S1 Microfluidic Integration**.**

Although we have specifically designed the system to rely on a simple single well format, removing the need for complex microfluidic integration or external pneumatic pressure controllers, it is possible to integrate microfluidics into the device if desired. (a) The GMR sensor array can be partitioned into 8 parallel microfluidic channels for high throughput analysis requiring very small reaction volumes. (b) Real-time binding curves of an assay with 50 ng/mL of CEA protein spiked into a 20 µL sample and delivered at 2 µL/s.

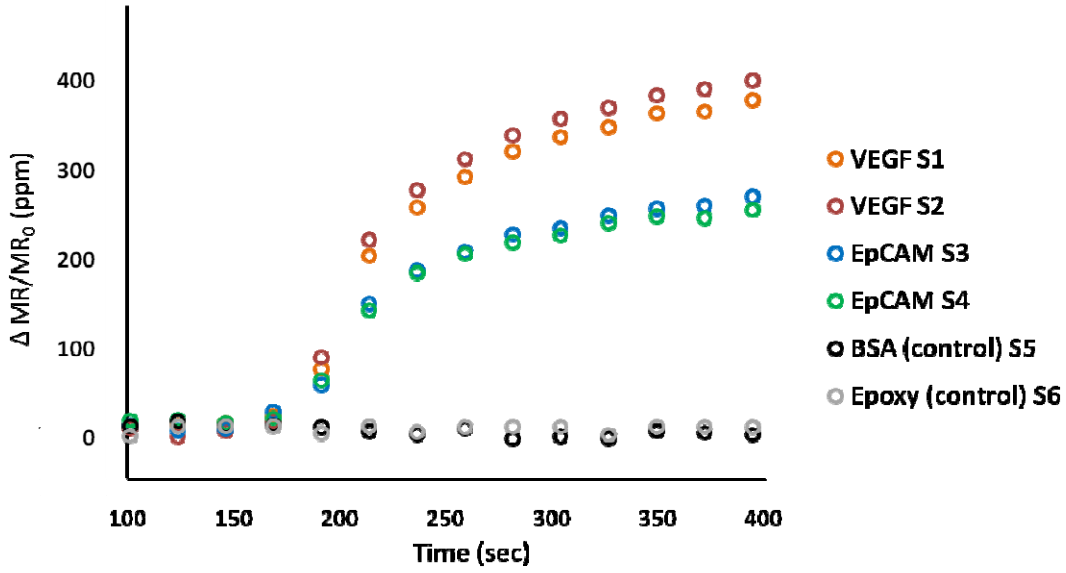

Fig. S2 Multiplexability and reproducibility of GMR sensor arrays.

Wash-free immunoassay run on the nanoLAB platform containing two spiked proteins, vascular endothelial growth factor (VEGF) and epithelial cell adhesion molecule (EPCAM) each present at 100 pg/mL. The stick was functionalized with duplicate VEGF and EPCAM sensors to monitor the reproducibility and demonstrate the multiplexability of the platform. The signals are highly reproducible across replica sensors and the assay exhibits very little non-specific binding as indicated by the bovine serum albumin (BSA) negative control. Furthermore, the noise in the electronics is minimal indicated by the epoxy covered control sensor.

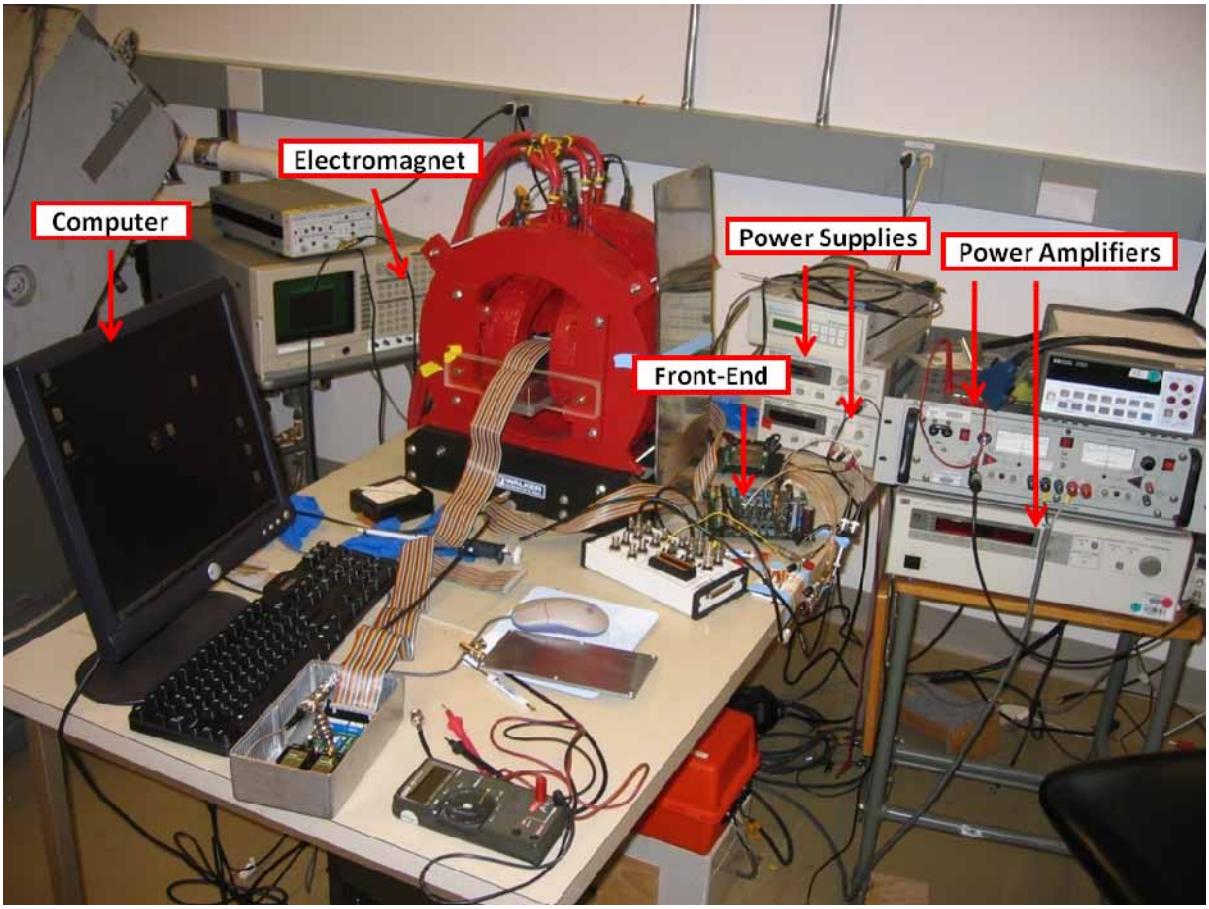

Fig. S3 Research grade biostation at Stanford University.

In a research setting (shown above), minimizing the size and reducing cost of a magnetic bio-station are not a top priority, rather the objective is to maximize the sensitivity. Scaling such a large room full of equipment into a portable platform poses many difficult engineering challenges. The nanoLAB accomplishes this without making great scarifies to the sensitivity of the device. Several key components of the system are labeled above. Fig. S4 and Fig. S5 show miniaturized implementations all of the same components integrated into a portable handheld device. Comparable sensitivity was achieved while the weight was reduced by over 1,000 times and the cost was reduced by a factor of 100.

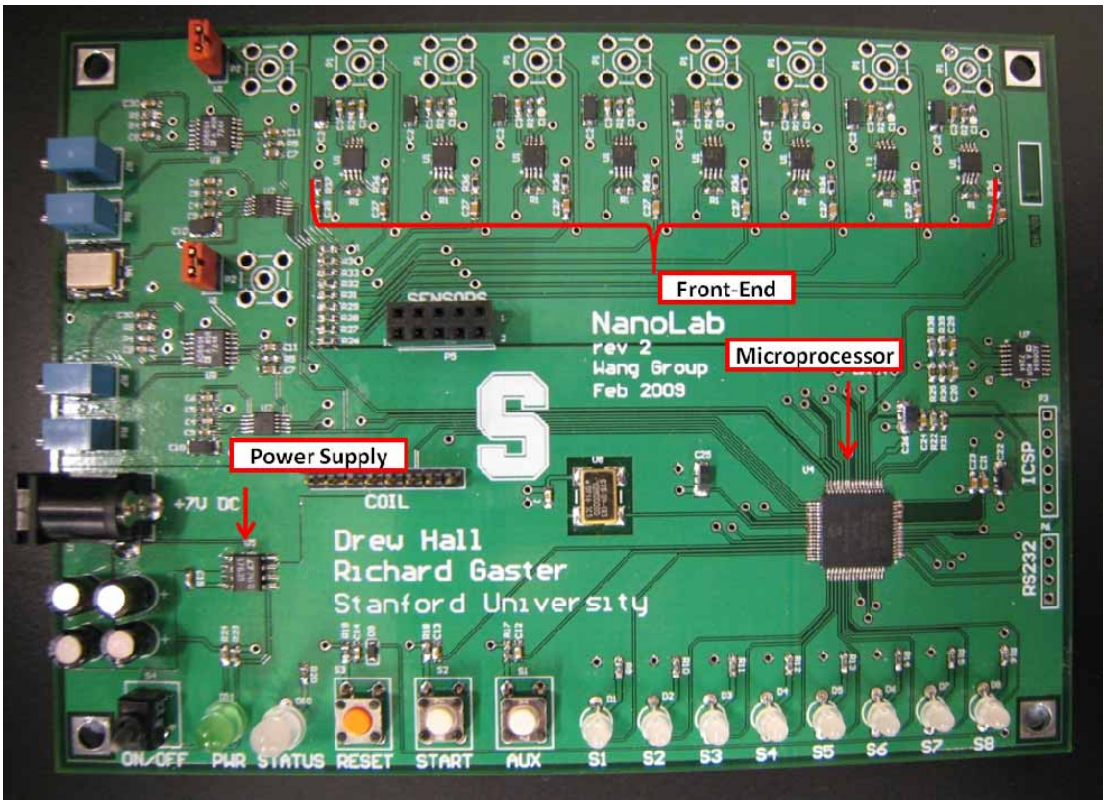

Fig. S4 Miniaturized data acquisition (DAQ) board.

The computer in the research setting has been replaced by a small microprocessor. While the microprocessor does not have the raw computational power (>10,000 million instructions per second (MIPS) for a PC compared to tens of MIPS for a microcontroller) or efficiency of a modern PC, the sheer processing power can be traded for latency. Furthermore, the signal processing algorithms have been minimized and optimized for this application. Also labeled in the above figure are the analog front-end and the power supply which have been significantly reduced in size. The monitor is replaced by a series of colored light emitting diodes (LEDs) that indicate the protein concentration in a very simple, easy to use format.

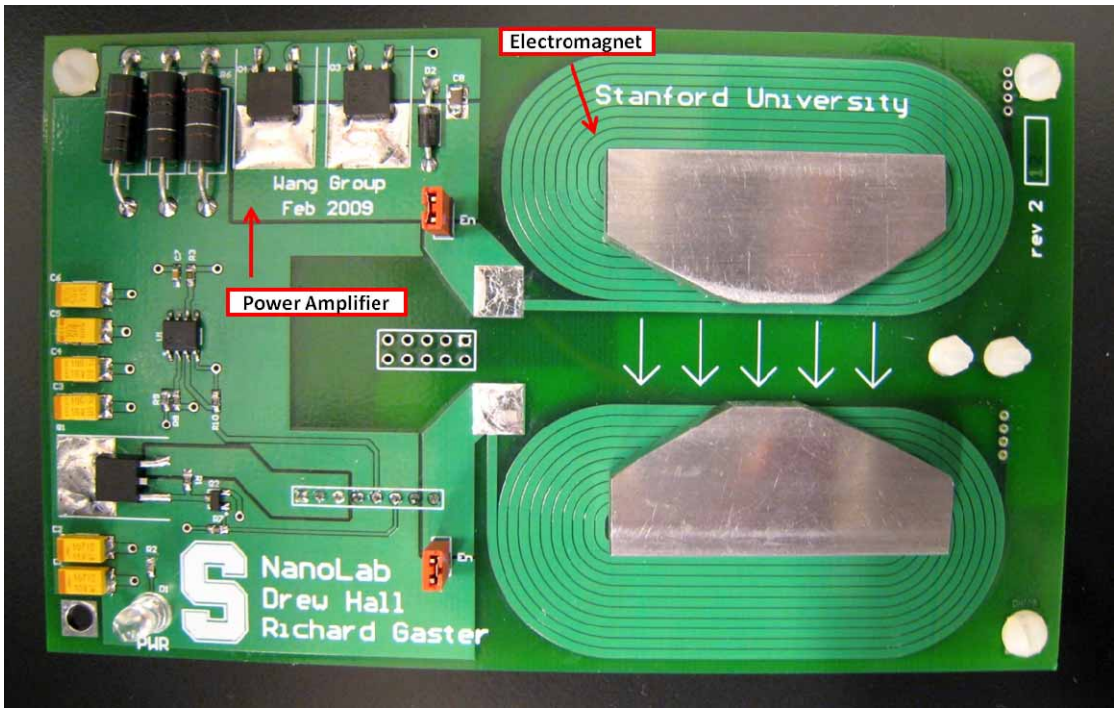

Fig. S5 Miniaturized electromagnet and power amplifier board

The large red electromagnet in Fig. S3 was replaced with a planar coil made out of traces on a PCB. Soft magnetic flux guides reorient the flux to be in-plane with the sensors. The electromagnet used in the laboratory draws over a hundred of watts of power from a wall outlet while this entire device draws only 2W from a rechargeable lithium ion battery. Using our portable coil, we are capable of generating magnetic fields of up to 35 Oe. The large power amplifier (Kepco BOP 50-4M) in Fig. S3 has been replaced with a class A power amplifier capable of delivering 2 amps continuous current to the electromagnet.

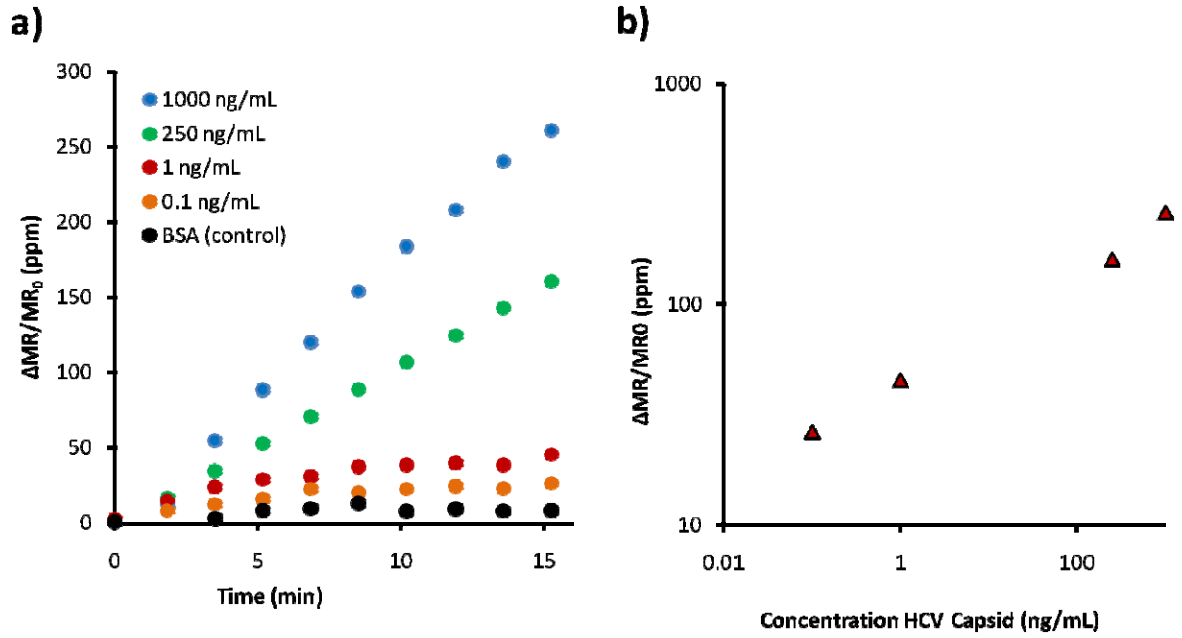

Fig. S6 Hepatitis C virus detection.

(a) Real-time binding curves of diluted HCV capsid protein at concentrations ranging from 1000 ng/mL to 100 pg/mL. The sensors, functionalized with bovine serum albumin (BSA) as a negative control, gave minimal signal indicating negligible non-specific binding of the wash-free assay. (b) Calibration curves for each marker of interest were generated after 15 minutes of incubation time.

nanoLAB detection station	Cost
Printed circuit boards	$2.00
Magnetic flux guides	$1.00
Electronic components	$105.00
Battery	$40.00
Metal enclosure	$18.00
Assembly	$28.00
Total:	**$194.0**

Table S1 The itemized cost of the reusable nanoLAB station.

The nanoLAB platform was custom designed using readily available commercial off-the-shelf components (COTS) housed in a metal enclosure. The cost of the system is calculated for low to medium volume (ten thousand units per year) manufacturing.

nanoLAB disposable stick	Cost
Printed circuit board and connector	$0.34
HCV capture antibody (abcam 2583)	$0.03
HCV detection antibody (abcam 58713)	$0.03
Magnetic nanoparticles (Miltenyi Biotec 130-048-101)	$1.88
GMR Sensor die	$1.00
Surface chemical reagents	$0.01
Assembly	$0.20
Total:	**$3.49**

Table S2 Itemized cost of the nanoLAB disposable stick.

The itemized cost of the one-time use disposable stick including the printed circuit board, sensors, capture and detection antibodies for 8 sensors, magnetic nanoparticles, surface chemistry, and assembly is tabulated above. The volume of production is calculated for one million units per year. It is further assumed that the antibodies are robotically spotted in nanoliter droplets to reduce the required volume and assembly cost.