Supplementary Information

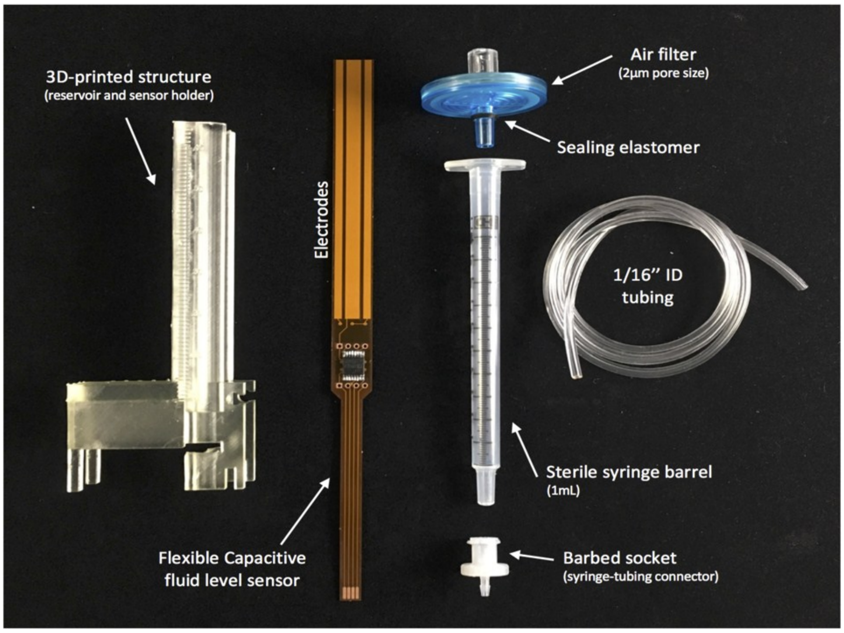

Figure S1 – Detail on individual components used for the assembly of the monitored hydrostatic chamber used for the feedback-controlled gravity-driven setup. For assembly, the syringe barrel, barbed socket, tubing and filter are connected together to be sterilized and then assembled onto the 3D-printed structure. The capacitive sensor is inserted into a thin slot at the back of the 3D-printed structure that positions the sensor in close proximity to the syringe barrel and thus the fluid. The sensor can be permanently attached to the 3D-printed structure with resin or adhesive to avoid mechanical induced drift.

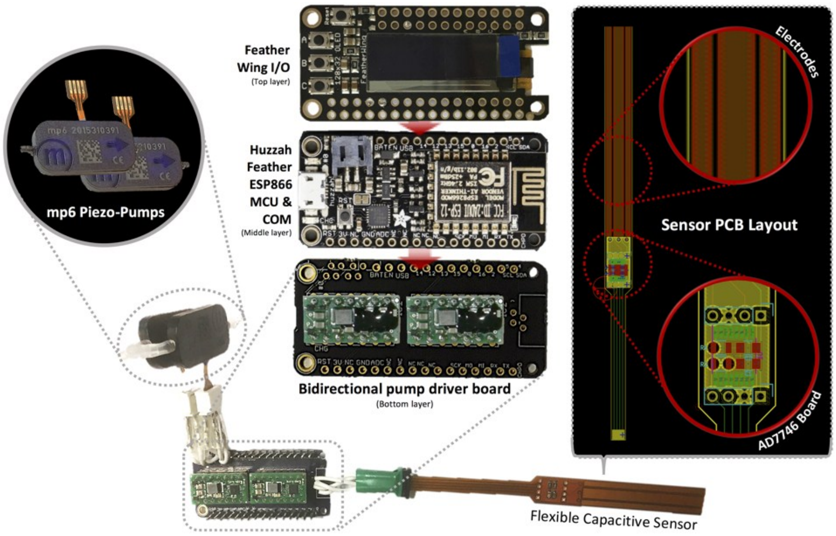

Figure S2 – Individual components of control hardware. Two mp6 piezoelectric pumps (top left) were connected to a bidirectional pump driver shield (bottom). This pump driver shield was controlled by a stackable Huzzah Feather ESP866 MCU & COM board containing the micro-controller unit. An OLED screen, as well as input keys can be seen in the Feather Wing I/O shield, which also interphase to the micro-controller board. The flexible capacitive sensor can be seen connected to the pump driver shield to interfase with the micro-controller (bottom). A close-up of the sensor PCB layout with details of the electrodes and AD7746 board is also shown (right).

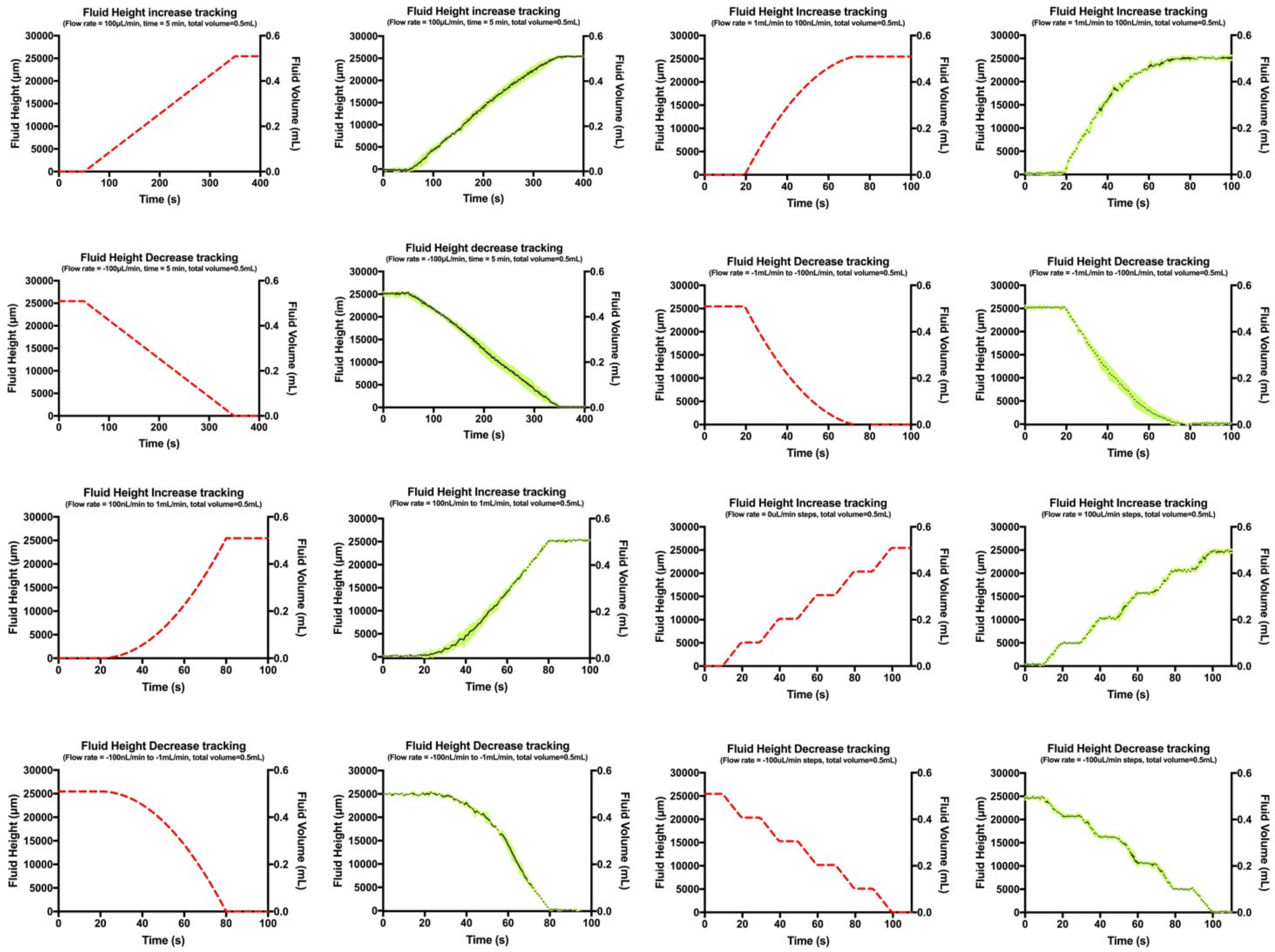

Figure S3 – Results of fluid height tracking with constant, and increasing/decreasing ramp and step flow-rate profiles. Programmed flow-rate settings for each experiment are shown below graph titles. Red dashed profiles denote the predicted fluid height and volume change over time as programmed in the calibrated syringe pump. Black points denote the average of three replicates following the same experimental conditions at each time point, while green error bars refer to the standard deviation of those samples. Inflow and outflow was tested for constant 100ul/min flow-rate, as well as for increasing and decreasing ramps (ranging from 100nl/min to 1mL/min). Finally, inflow and outflow experiments were also conducted for a step-like profile with 100ul/min amplitude. Flow rates were calculated every 10s and compared with flow rates know from simulations. Constant and dynamic additions or extractions of fluid generated linear fluid height increase and decrease profiles that were similar for both simulations and experimental results. Increasing and decreasing ramp profiles generated second order profiles similar to those predicted by simulations. Similar results were found for the step flow profiles.