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Supplementary Materials for

Physically defined long-term and short-term synapses for the development of reconfigurable analog-type operators capable of performing health care tasks

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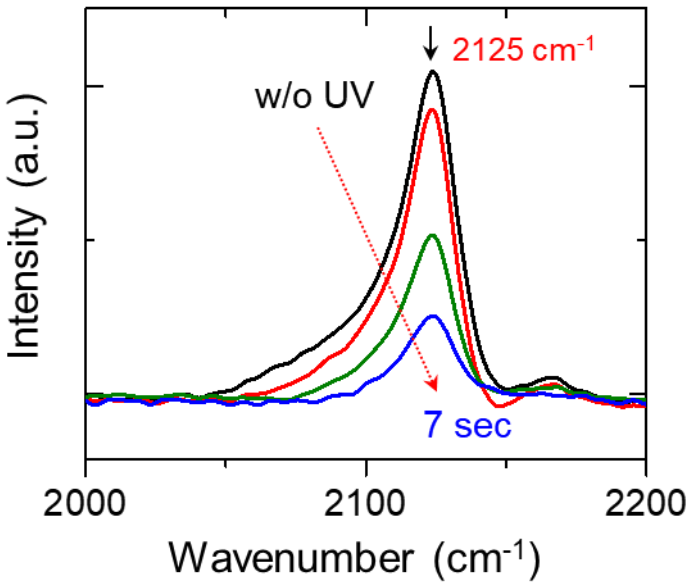
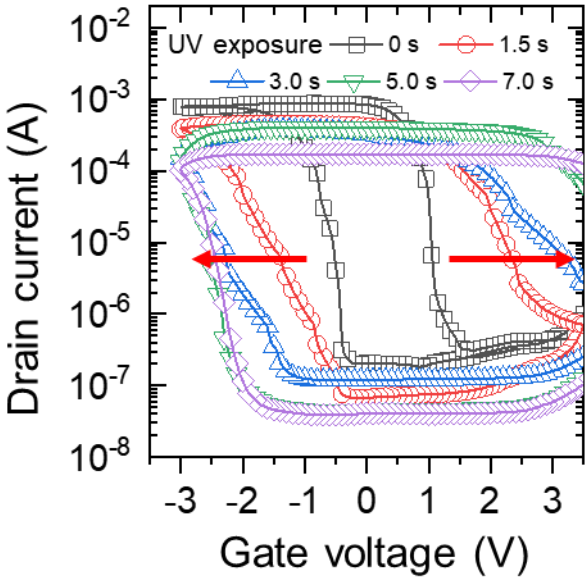
This PDF file includes:

Supplementary Figures

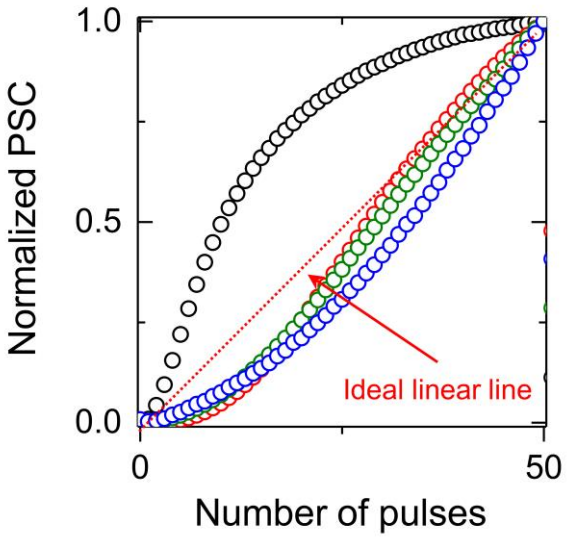


Supplementary Fig. S1 | Confirmation of the photochemical reaction.
Fourier transform infrared (FTIR) spectroscopy of P3HT under varied UV irradiation time from 0 to 7 s. The peak appears at 2125 cm^{-1} is originated from the N≡N stretching vibration in the azide group.

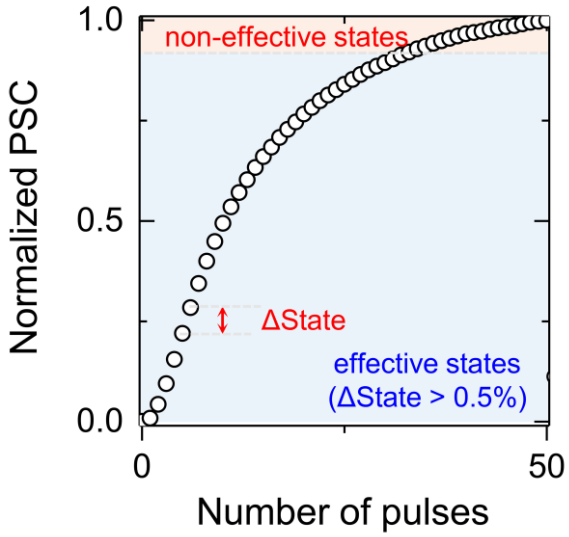


Supplementary Fig. S2 | Confirmation of ion-penetration behavior by tracking hysteresis behavior as function of the reaction time.

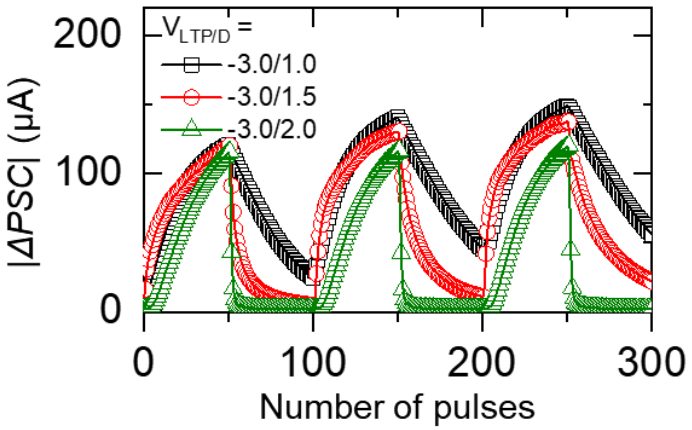
Typical transfer characteristics (PSC–V_{WC} curve) of vertical synapse with varied UV exposure time.



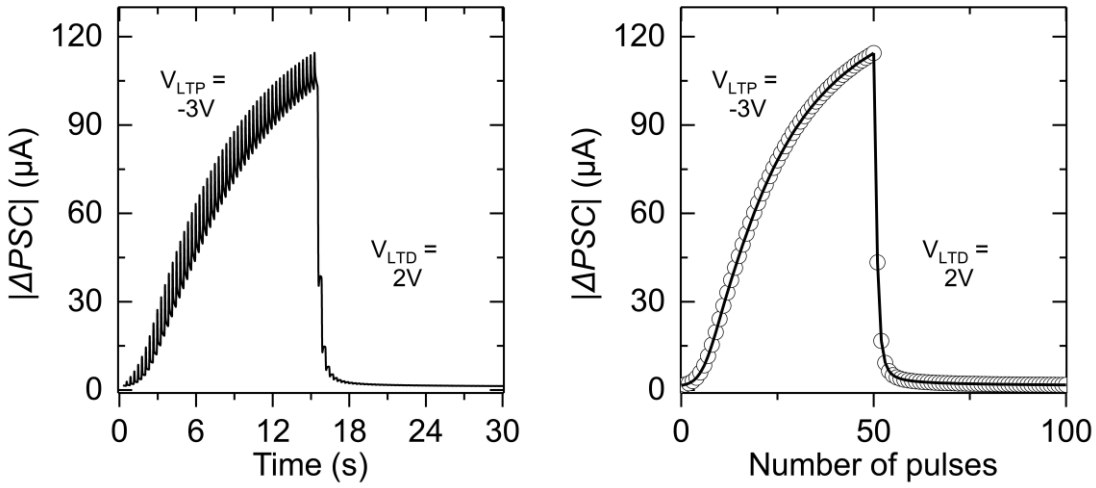
Supplementary Fig. S3 | Normalized PSC states in the LTP curve.
Measured(dots) and ideal linear line plots from LTP curves of **Fig. 3d**.



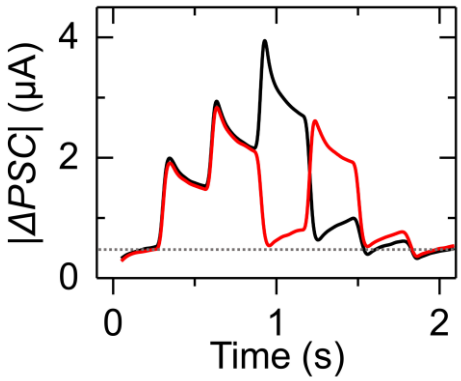
Supplementary Fig. S4 | Method for calculation of the effective number of states.
The normalized PSC states with the dynamic range were plotted as a function of pulse number. And then, the states having Δstate above the 0.5% of the dynamic range were defined as the effective states.



Supplementary Fig. S5 | LTP/D curves under varied depression voltage pulses.
Among the varied depression voltages for the LTP/D measurement, the V_{LTD} of 2V showed the most reliable reset property.

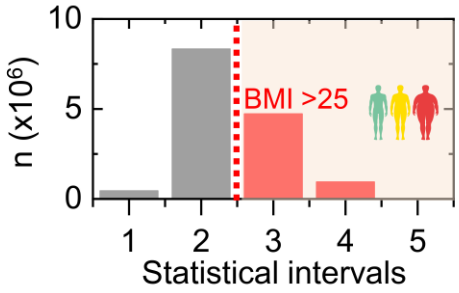


Supplementary Fig. S6 | Extraction of representative PSC state from real-time LTP/D curve.
The LTP/D curve has 50 potentiation and 50 depression cycles, and each update cycle consists of 10 data points. The first data point represents the current upon pulse input, and the remaining 9 data points represent the following retention current. The last data point of the cycle, the point before the following pulse input, is defined as a representative PSC state.

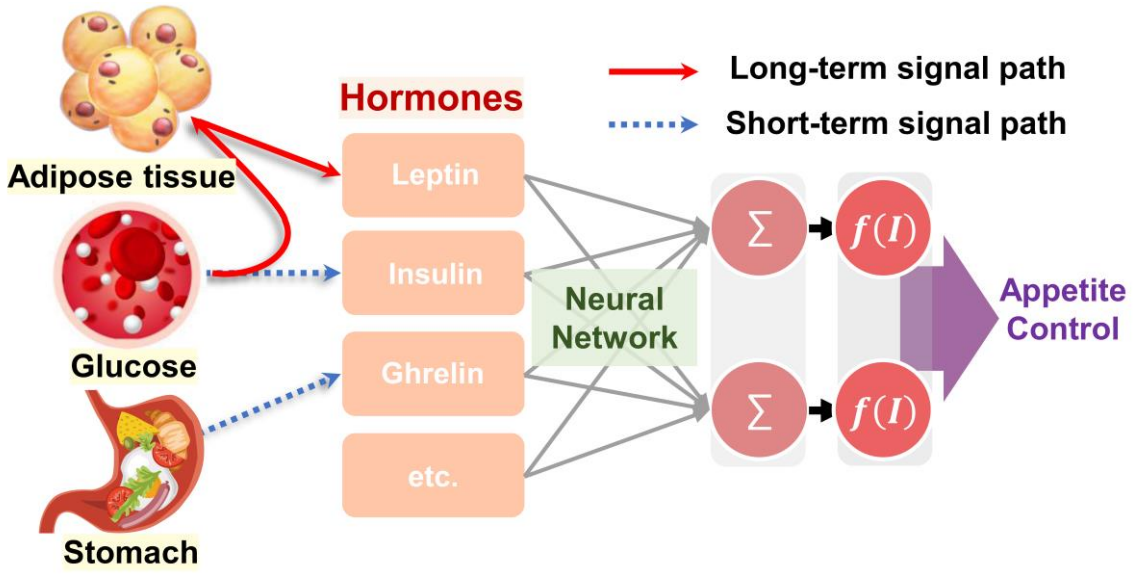


Supplementary Fig. S7 | Verification of state stability by overlapping of PSC responses from regular and irregular pulse updates.

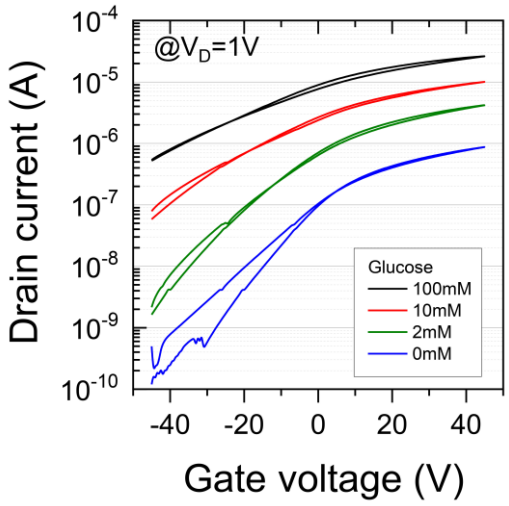
The regular pulse set consists of consecutive 3 potentiation pulses followed by 3 depression pulses(PPPDDD) while the irregular pulse set has the mixed ordering of potentiation and depression pulses(PPDPDD).



Supplementary Fig. S8 | Pre-recorded statistical data for reconfigurable synaptic logic operation. Distributions of body mass index (BMI) for the Korean population in 2020 by a statistical interval.

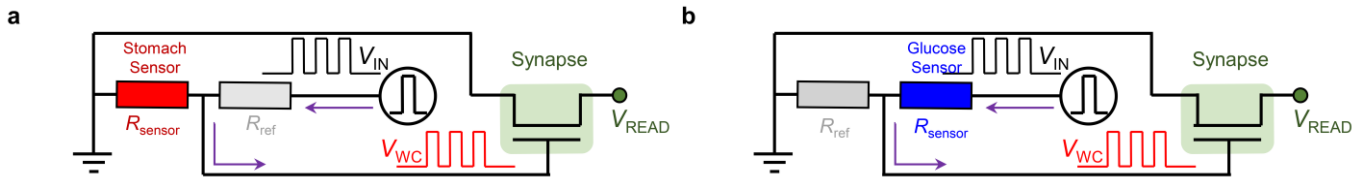


Supplementary Fig. S9 | Schematic diagram of the human appetite controlling system.
Neural signals transmitted through hormones from each cell and tissue are integrated and processed through a biological neural network to control appetite.

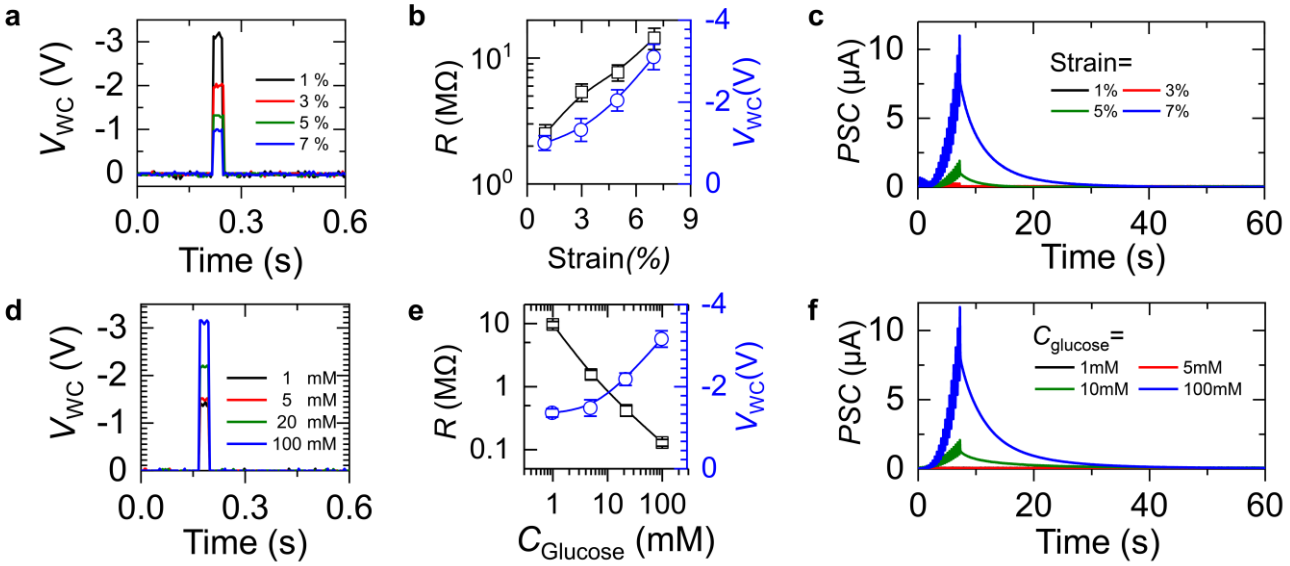


Supplementary Fig. S10 | Transfer curves of an indium gallium zinc oxide (IGZO) transistor under varying glucose concentrations.

The IGZO transistor was fabricated on SiO_2/Si^{++} wafer and the test solution containing glucose was dropped on the channel. The gate voltage was applied through the 100-nm-thick SiO_2 dielectric layer.

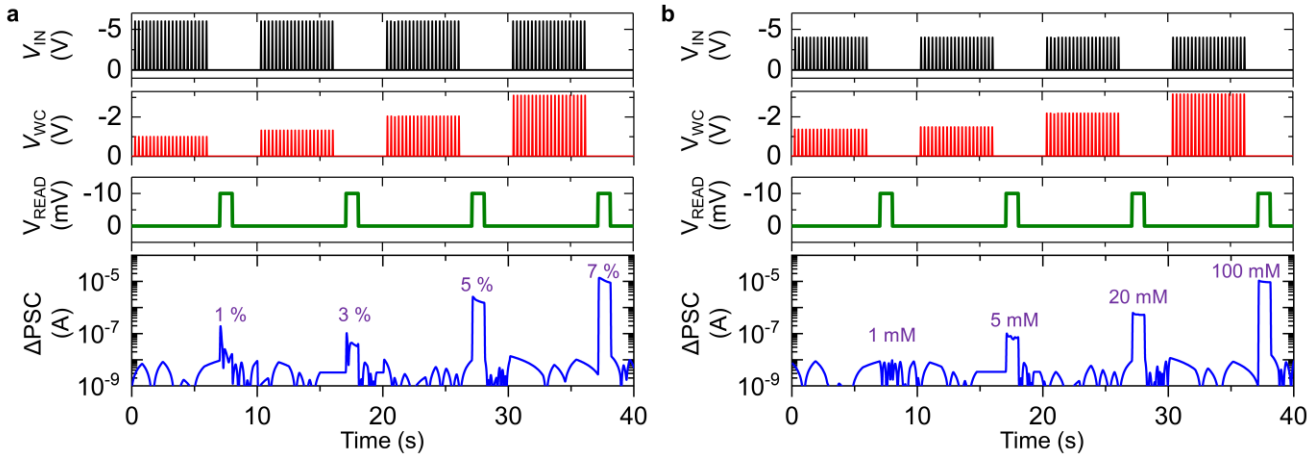


Supplementary Fig. S11 | Circuit diagrams of the sensor-synapse unit based on a voltage divider. **a**. Strain sensor (to simulate the stomach sensor) and **b,** glucose sensor connected to the synapse. The V_{WC} applied to the synapse is amplified upon stomach expansion and increases glucose level.

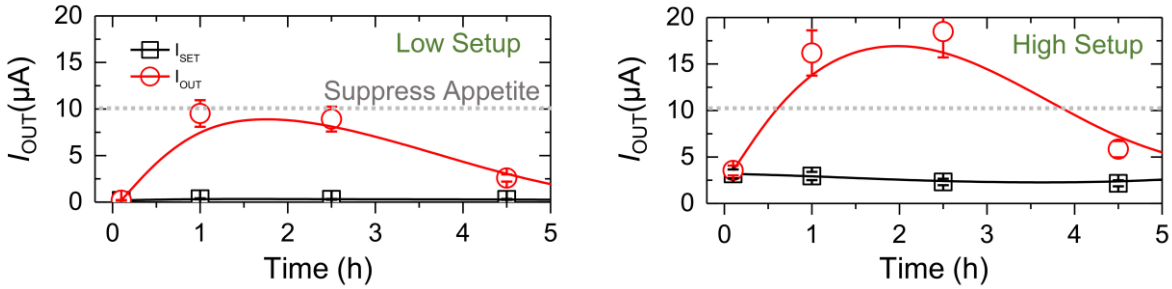


Supplementary Fig. S12 | The resistance changes of the sensors and resulting V_{WC} and synaptic current change.

a. Measured V_{WC} inputs from stomach sensor-synapse unit upon varied mechanical stress. **b.** A plot of resistance and corresponding V_{WC} as a function of the applied strain. **c.** LTP and retention PSC of the synaptic device connected to the strain sensor under varied strain. **d.** Measured V_{WC} inputs from the glucose sensor-synapse unit upon varied glucose levels. **e.** A plot of resistance and corresponding V_{WC} as a function of the glucose level. **f.** LTP and retention PSC of the synaptic device connected to the glucose sensor under varied glucose levels.



Supplementary Fig. S13 | Real-time plots of V_{IN}, V_{WC}, V_{READ}, and corresponding PSC of a sensor-synapse integrated unit. a. Real-time plots of V_{IN}, V_{WC}, V_{READ}, and corresponding PSC of a sensor-synapse integrated device simulating stomach expansion and **b**. increasing glucose level.



Supplementary Fig. S14 | Retention current of the LTS and read PSC of the appetite control system. Plots of the set current of LTS (black) and read PSC of the appetite control system in normal and obese cases.