Representative Research #1

On-Skin paintable Biogel for Long-Term High-Fidelity Electroencephalographic Recording

Science Advances 2021 [project page]

Contribution:

- **EEG signals become noisier and the detective accuracy decreases over time**

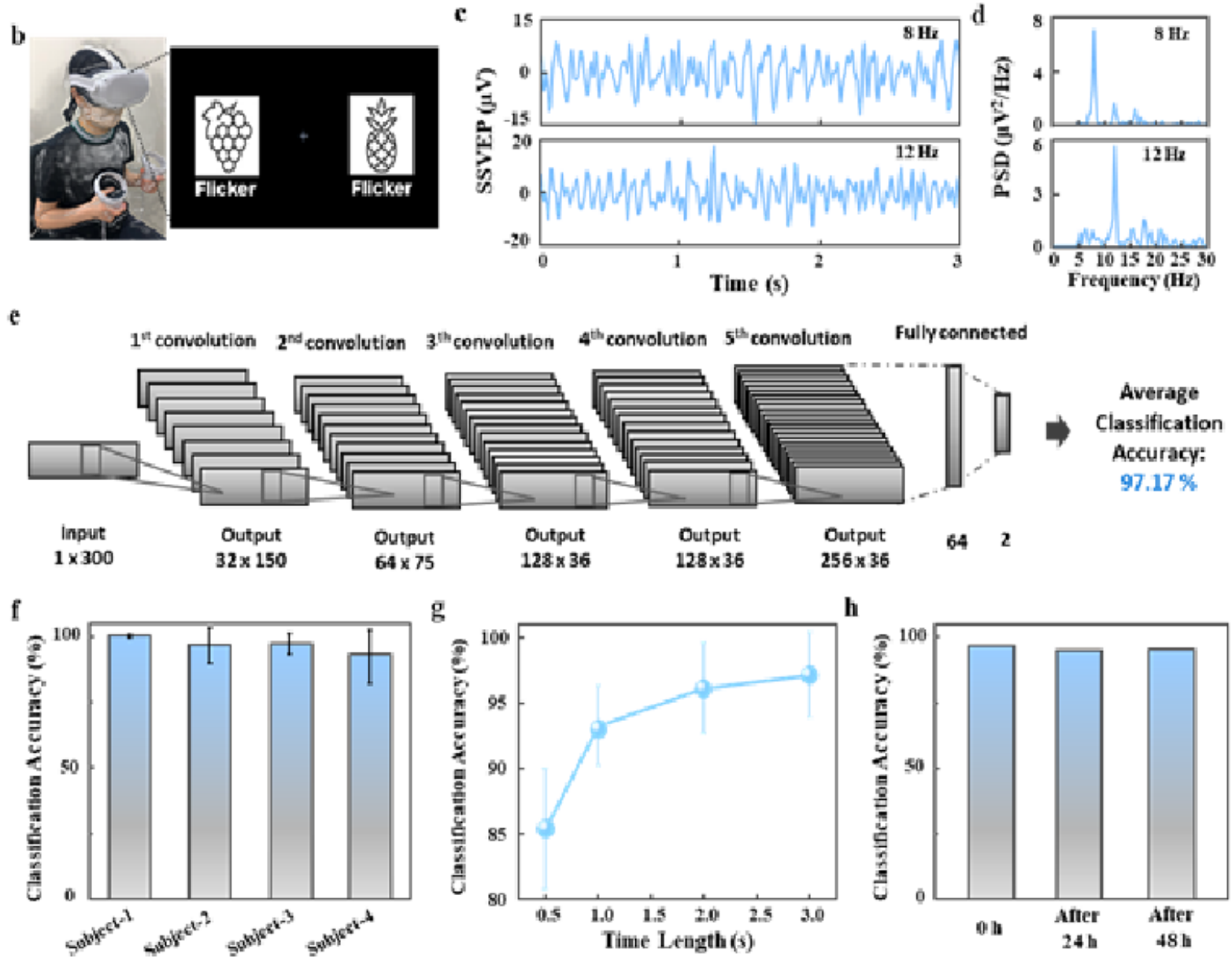
High-level Idea:

- **Use VR to strengthen visual intents of subjects**
- **Augment datasets by sliding time window**

Result:

- **constructed high-accuracy BCI system for long-term**
- **improve detection accuracy from 90% to 99%**

Representative Research #1



Representative Research #2

Evaluation of Memory Characteristics of informational processing capacity of Cultured Neuron

Contribution:

- **What calculations living neural network is good at is still un-known**

High-level Idea:

- **Evaluate an information processing capacity of a cultured neuron by reservoir computing**
- **Measure the IPC of memory characteristics by how fast it could reach the target function(f)**

$$f = binary\ step\ function(\gamma) = \begin{cases} 1\ (t \leq \gamma) \\ 0 (t > \gamma) \end{cases}$$

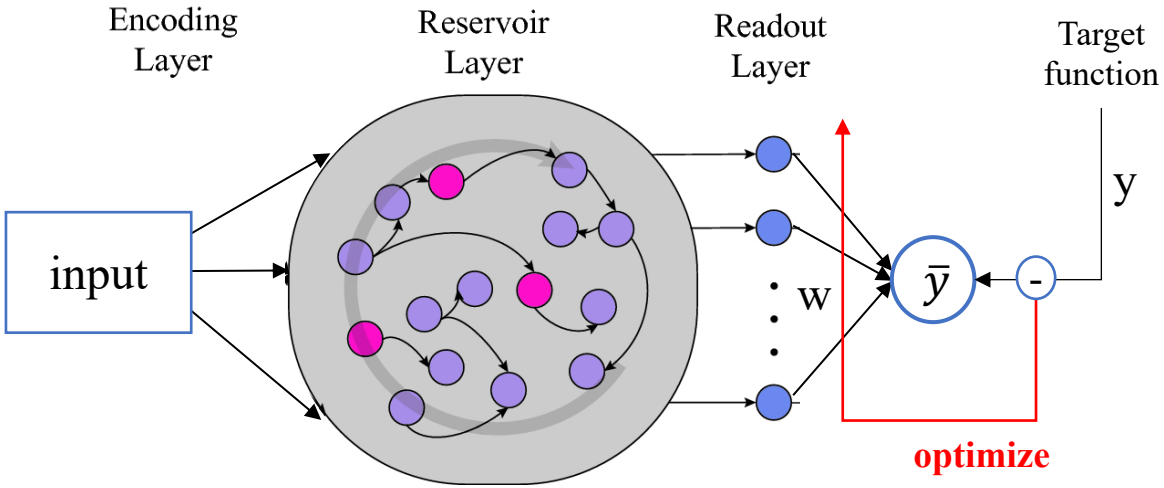
Result:

- **Sometimes the function converged, sometimes it didn't. I couldn't figure out what affect it**

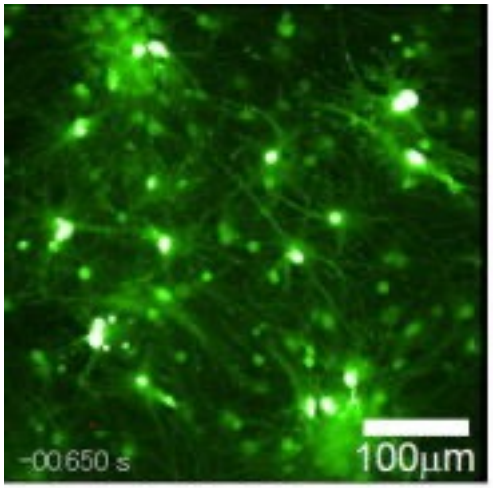
Representative Research #2

Settings:

- 26400 Electrodes
- 1024 Readout
- 32 Stimulus input



Reservoir computing for evaluate IPC



Cultured neurons (rat cortex)

Methods:

- Stimulate 1 electrode every 1s
- Calculate linear combination of all neurons
- Update weights based on difference between output and target function(RLS algorism)
- $f = binary\ step\ function(\gamma) = \begin{cases} 1\ (t \leq \gamma) \\ 0 (t > \gamma) \end{cases}$

Representative Research #2

Optimizing Algorism: RLS algorism

$$e(t) = \boldsymbol{W}(t)\boldsymbol{x}(t) - y$$

$$\boldsymbol{Q}(t) = \boldsymbol{P}(t)\boldsymbol{x}(t+1)$$

$$\boldsymbol{k}(t) = \frac{\boldsymbol{Q}(t)}{1 + x^T(t+1)\boldsymbol{Q}(t)}$$

$$\boldsymbol{P}(t+1) = \boldsymbol{P}(t) - \boldsymbol{k}(t)Q^T(t)$$

$$\boldsymbol{W}(t+1) = \boldsymbol{W}(t) + e(t)\boldsymbol{k}(t)$$

$$\boldsymbol{P}(0) = \boldsymbol{I}, \boldsymbol{W}(0) = \boldsymbol{0}$$

Representative Research #3

The Effect of Electrode Adhesiveness on Motion Artifact in EEG monitoring

JSBME 2021, Young Investigator Workshop

Contribution:

・Causes of the motion artifact of EEG are diverse and difficult to assess although it is the biggest problem of EEG

High-level Idea:

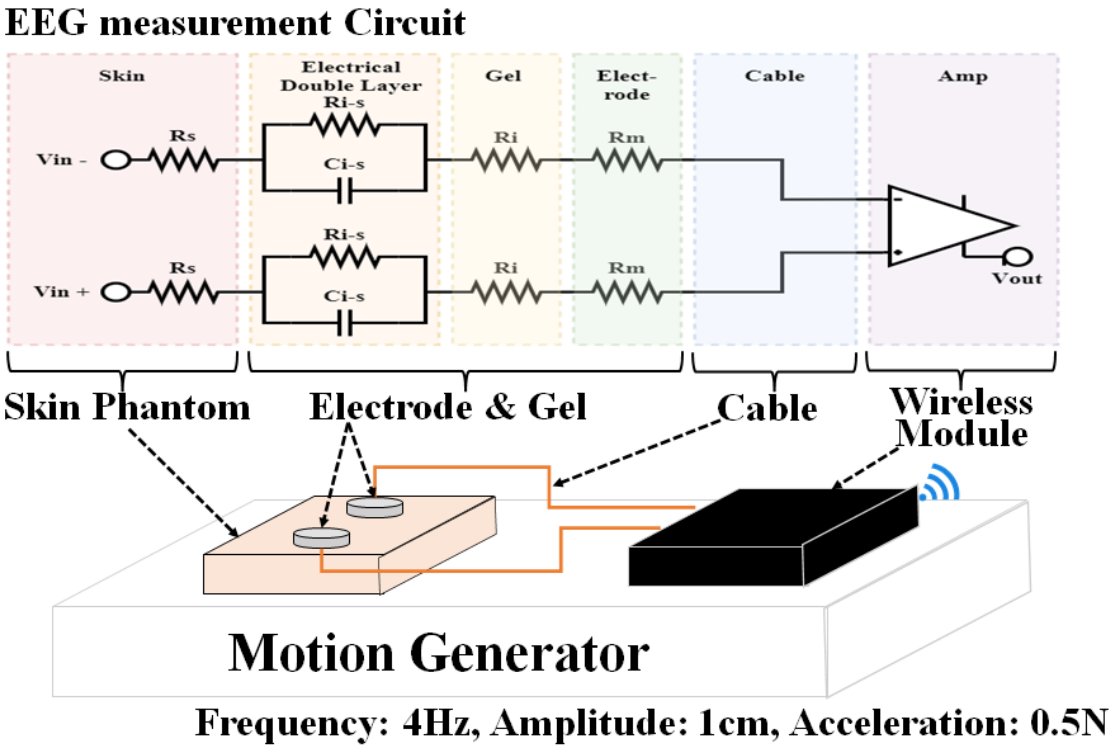
- **Make an instrument that can measure only motion artifact**
- **Create artificial measurement systems that don't use test subjects**

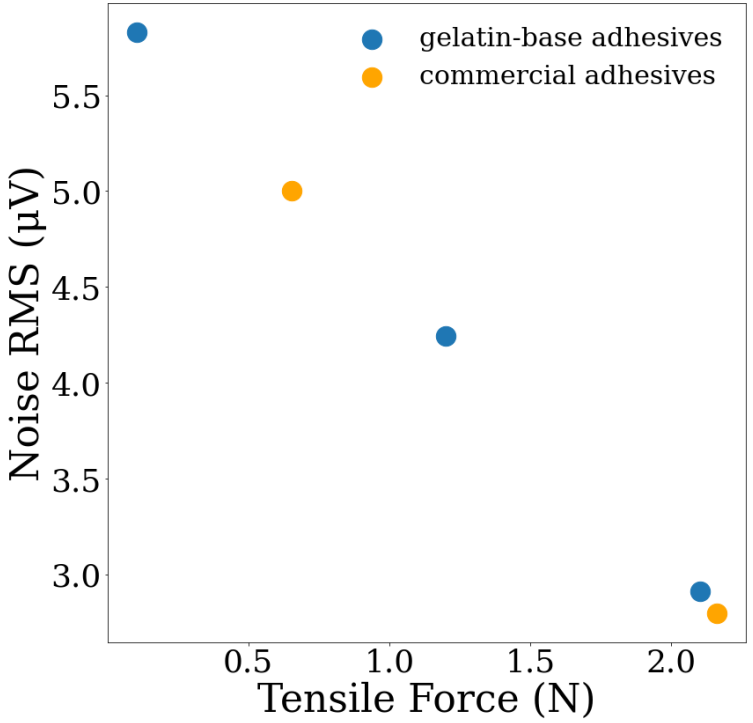
Result:

・Our system enables to quantify the motion artifact among different electrode.

・We firstly prove that the adhesiveness relates to motion artifact

Representative Research #3



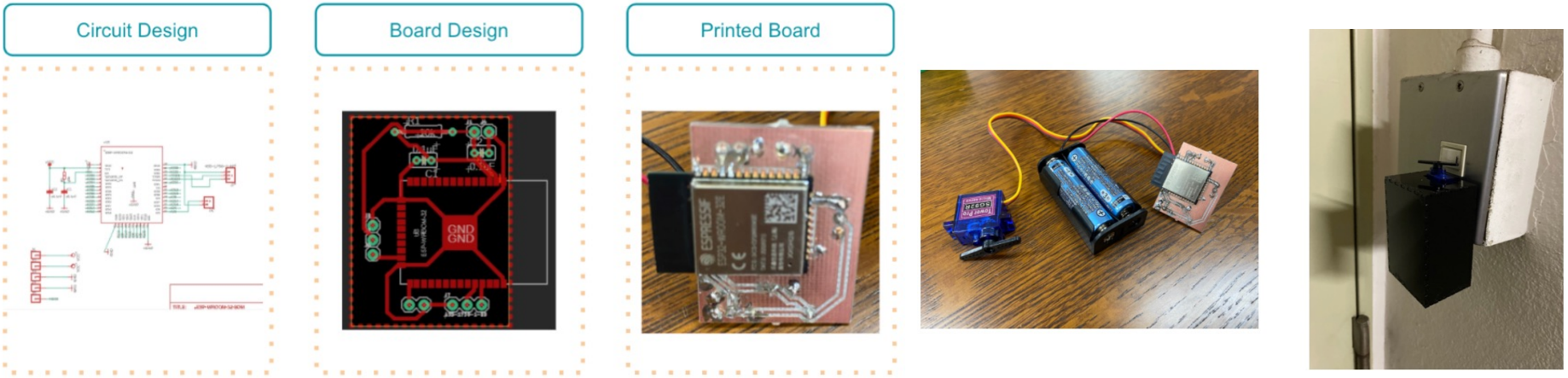


Result:

- **Create artificial measurement systems for motion artifact (left figure)**
- **the result proved relationship between adhesiveness and motion artifact (right figure)**

Side Projects

Remote Switch: Bluetooth socket programming, Microcontroller design



Cultured Brain Robot: Close-loop reservoir computing, robot control