

Тема:

Використання нейро-комп'ютерних інтерфейсів для збору та накопичення інформації про користувачів веб ресурсів.

Науковий керівник:

Глибовець Андрій Миколайович

Задача:

Розробити архітектуру системи збору та накопичення інформації про користувачів веб ресурсів з використанням нейро-комп'ютерних інтерфейсів.

Аналіз існуючих нейро-комп'ютерних інтерфейсів

Виробник	Прилади/ Кількість каналів	Частота дискретизації	Тип зв'язку
Emotiv	INSIGHT:5 EPOC+:14 EPOC FLEX:32	128 Hz	Wireless
Muse	4	256 Hz	Wireless
Open BCI	Up to 16	256 Hz	Wireless

Аналіз існуючих нейро-комп'ютерних інтерфейсів

shop.openbci.com/collections/frontpage

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Low-cost Biosensing Starter Kit

\$ 884.99 USD



DIY Neurotechnologist's Starter Kit

From \$ 1,499.99 USD



All-in-One Biosensing R&D Bundle

\$ 3,449.99 USD



OpenBCI Instructional Bundle (5 kits)

\$ 4,699.99 USD



All-in-One Gelfree Electrode Cap Kit

\$ 2,799.99

"Great product if you want to learn the basics of medita and very good to be able to have feedback on your state Bruno Echagayen R."

★★★★★ 2238 Reviews

DEVICE +1 YEAR SUBSCRIPTION

Muse S (Gen 2) Premium Subscription Bundle

~~\$494.98~~ **\$419.98 USD**

Device +1 Year Subscription Device Only Device Only (8 pack)

Last Chance to Save on Memorial Day Deals: FREE SHIPPING for EPOC X and Flex Setups. Offer ends MAY 31. Code: FREE5H4P-MAY23

EMOTIV HEADSETS SOFTWARE SOLUTIONS THE SCIENCE NEWS SHOP

LOGIN CART / \$0.00



EMOTIV EPOC[™] X

32-Channel Wireless EEG Headset.

Shop Now



EMOTIV EPOC[™] X

14-Channel Wireless EEG Headset.

Shop Now



EMOTIV INSIGHT[™]

5-Channel Wireless EEG Headset.

Shop Now

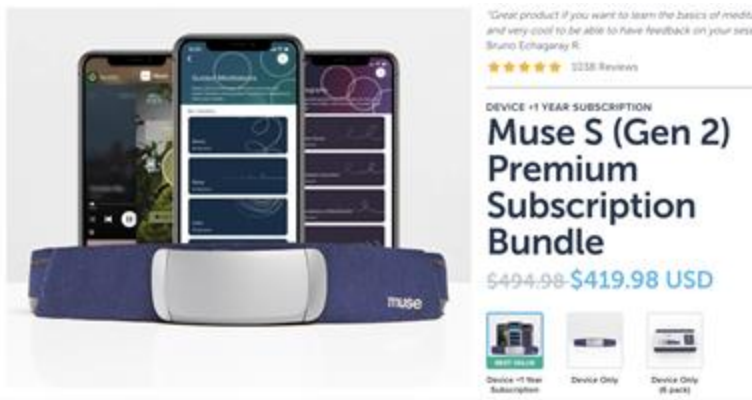


EMOTIV NINE[™]

2-Channel Wireless EEG earbuds, with audio and mic.

Shop Now

Аналіз існуючих нейро-комп'ютерних інтерфейсів

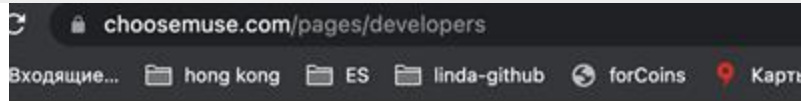


7 Advanced Sensors That Track Your Brain & Body

Muse passively measures brain signals, much like a heart rate monitor senses your heartbeat, and serves as a research-grade brain fitness tool.

Its 7 finely calibrated EEG sensors - 2 on the forehead, 2 behind the ears, and 3 reference sensors - detect and measure the activity of your brain. Its PPG sensor measures your heart rate, while an accelerometer and gyroscope measure your breath rhythm and body movement.

Muse has been tested and certified in accordance with Canadian, US, and European regulatory standards (FCC, UL, CE).



How It Works Benefits Science Ap

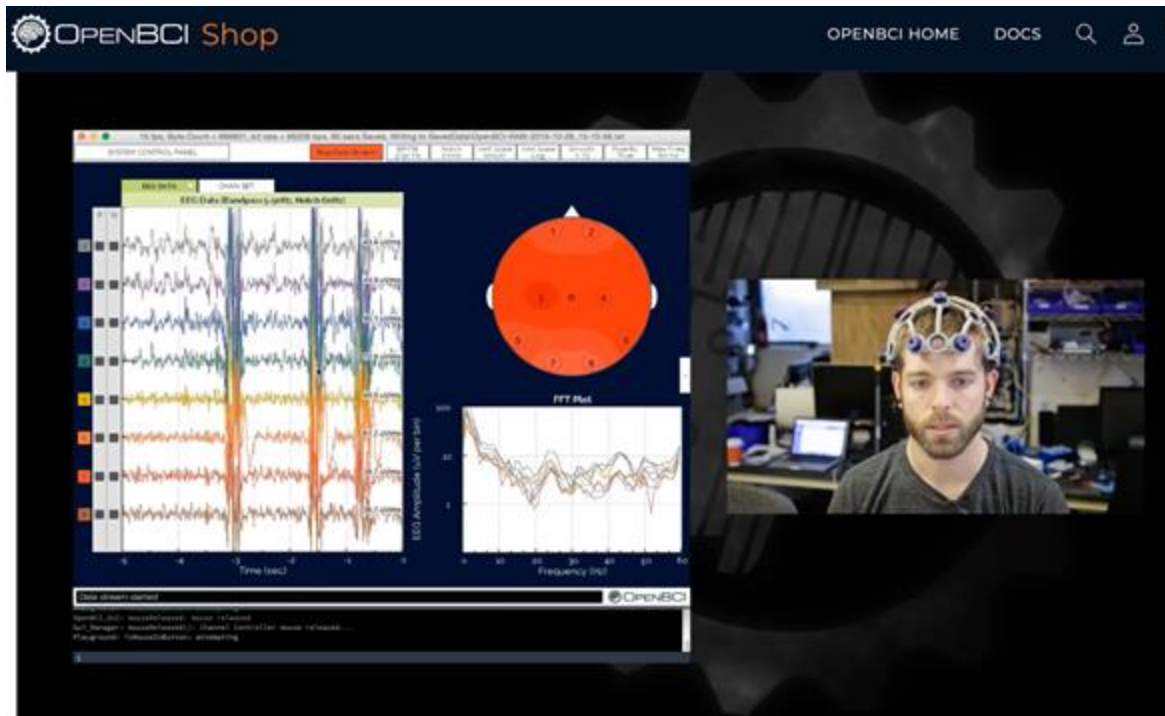
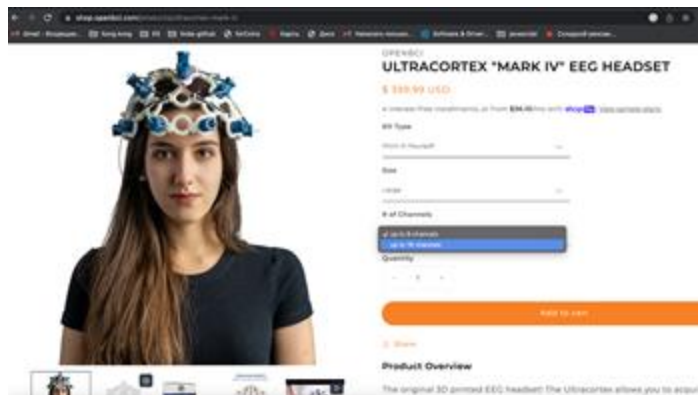
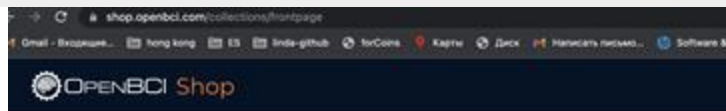
Register for API access for interacting with Muse devices through Muse SDK

Muse SDK handles the Bluetooth connection and asynchronously manages that connection.

By linking with the Muse library, an application can access signals from the sensors on the Muse headband (EEG, PPG, accelerometer etc.) along with a few processed signals as identified in the SDK documentation.

Also offered in the library are classes for saving and reading data in the .muse file format, simulating playback, and managing log messages. Available for iOS and Android. Windows, Unity, and Unreal to come!

Аналіз існуючих нейро-комп'ютерних інтерфейсів





5 CHANNEL EEG

SEMI-DRY POLYMER SENSORS

9 AXIS MOTION SENSORS

Зовнішній вигляд Emotiv INSIGHT

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6 branches

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About

Example with Cortex V2/V3 API

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Releases

No releases published



thamha-emotiv Merge pull request #187 from Emotiv/python-... [efb73f1](#) on Nov 29, 2022 85 commits

.github/workflows	Create codeql-analysis.yml	last year
certificates	use self signed certificate for python example and replace Ne...	7 months ago
cpp-qt	rename Emotiv App to Emotiv Laucher (#148)	2 years ago
csharp	use self signed certificate for python example and replace Ne...	7 months ago
nodejs	Update README.md	last year
python	use self signed certificate for python example and replace Ne...	7 months ago
unity	Cor 4301 update unity example (#178)	last year
.gitignore	introduce unity example	3 years ago
.gitmodules	remove obsoleted files and update readme	3 years ago
LICENSE	Update LICENSE	3 years ago
README.md	Update README.md	last year

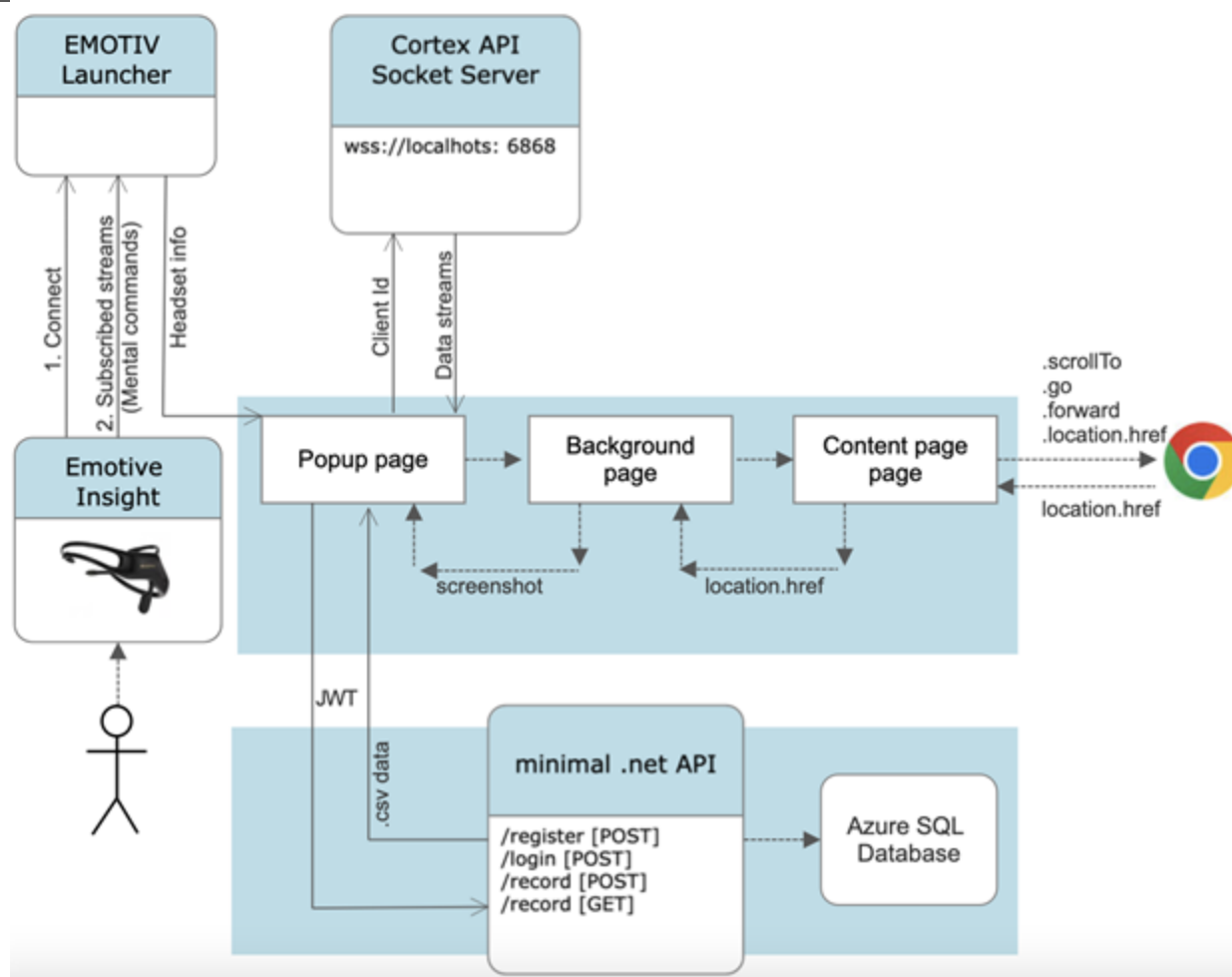


Рисунок 1 – Загальне архітектурне рішення.

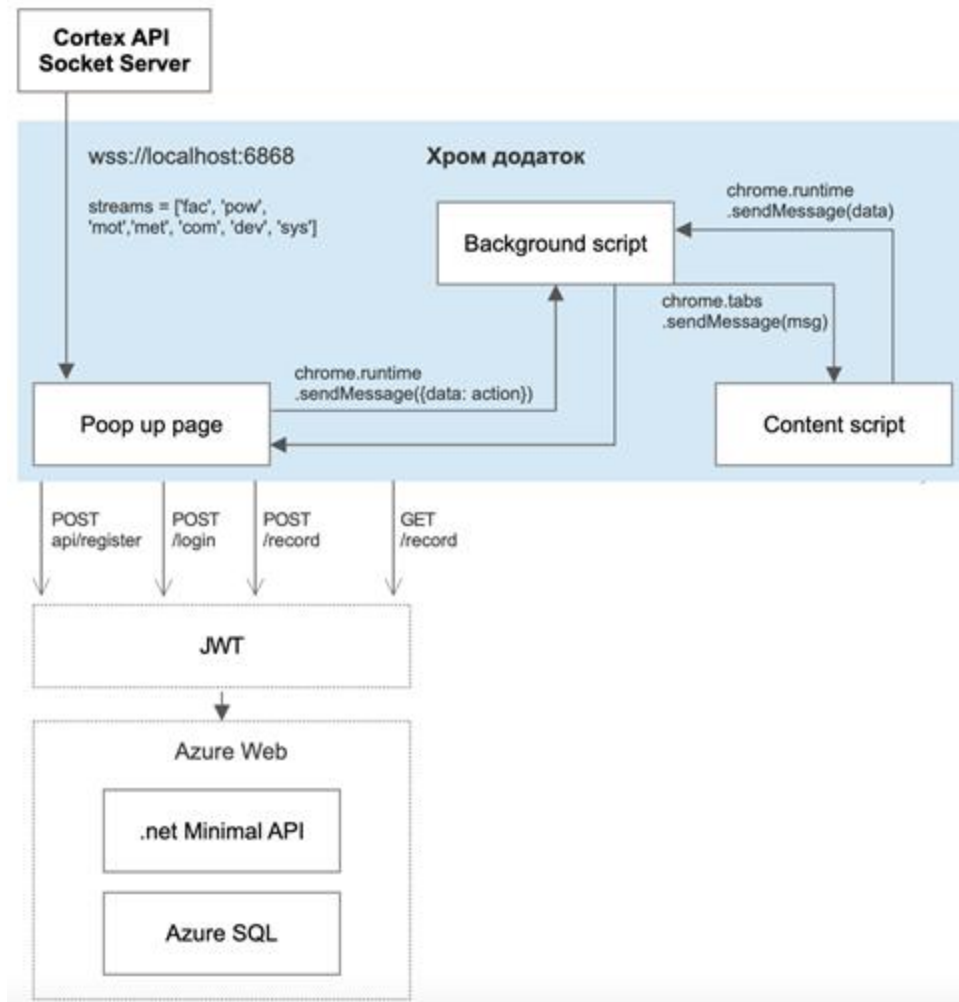
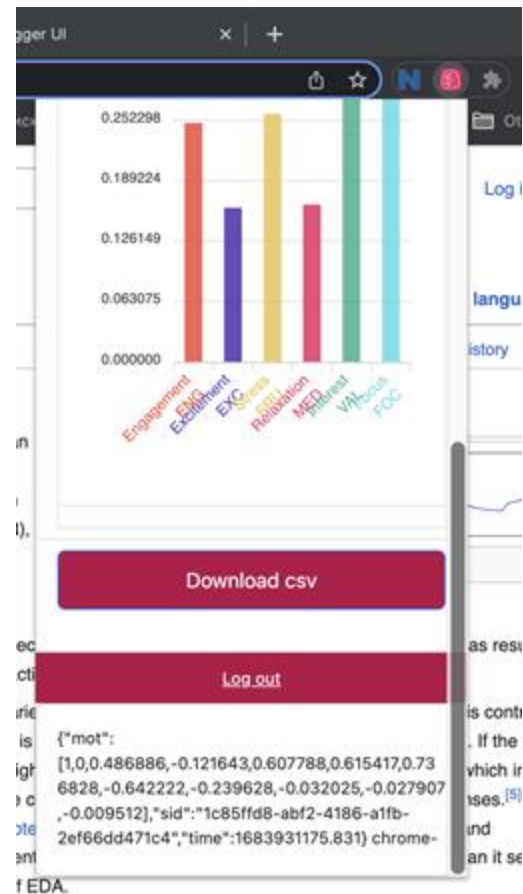
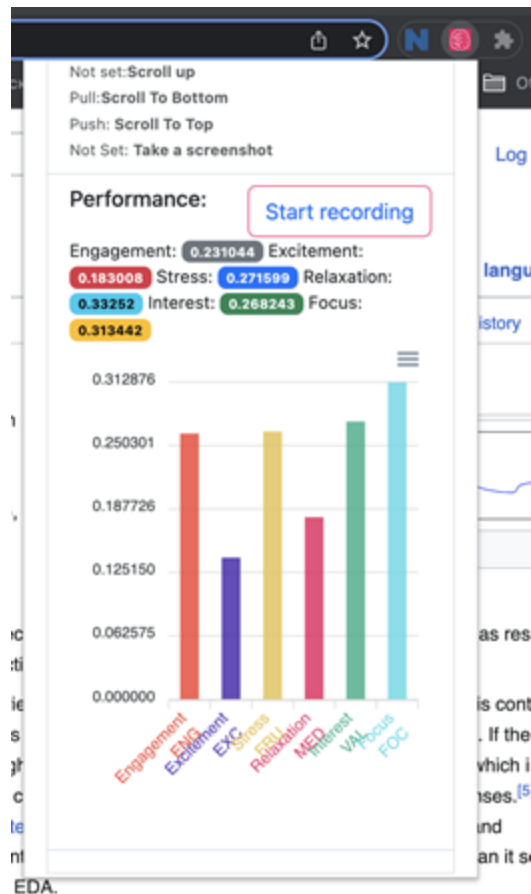
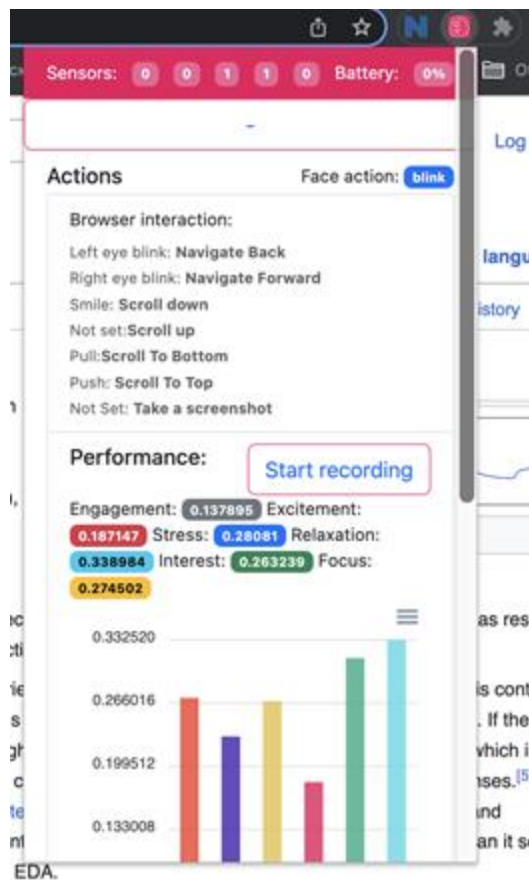


Рисунок 2 – Взаємодія між компонентами.

Розроблено прототип

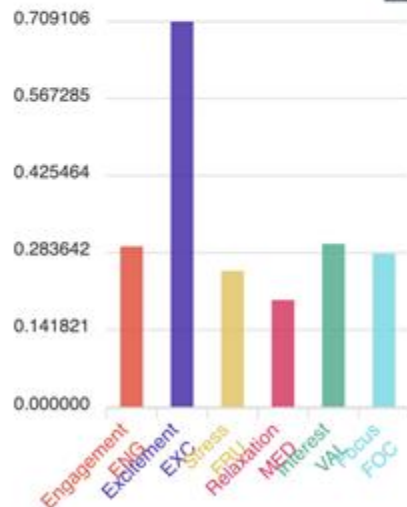


Not set: Scroll up
Pull: Scroll To Bottom
Push: Scroll To Top
Not Set: Take a screenshot

Performance:

Stop recording

Engagement: 0.608492 Excitement:
0.180275 Stress: 0.248684 Relaxation:
0.25868 Interest: 0.237071 Focus:
0.179119



Elements Recorder Performance insights Network 273 2

Filter ☐ Invert ☐ Hide data URLs

All Fetch/XHR JS CSS Img Media Font Doc WS Wasm Manifest Other ☐ Has blocked cookies

☐ Blocked Requests ☐ 3rd-party requests

100 ms 200 ms 300 ms 400 ms 500 ms 600 ms

Name × Headers Payload Preview Response Initiator Timing >>

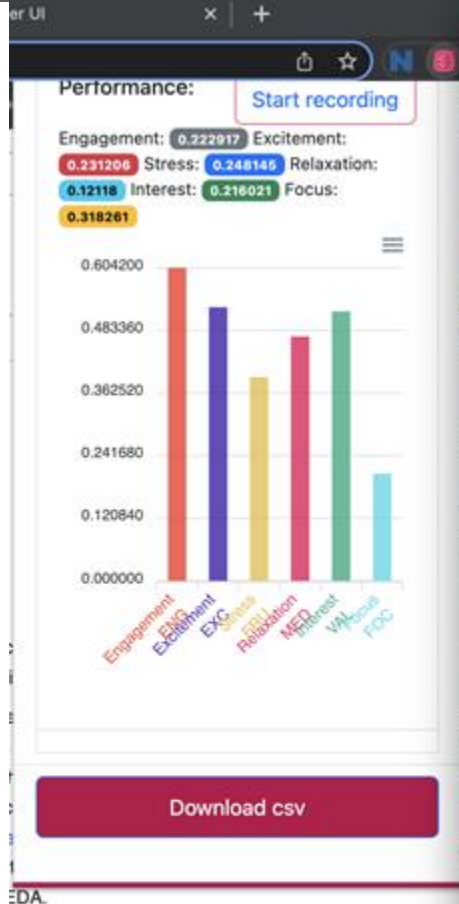
☐ record

▼ Request Payload view source

▼ [{"name": "user2", engagement: 0.709488, excitement: 0.284114, stress: 0.331528, relaxation: 0.4144, interest: 0.430185, focus: 0.493005, url: "localhost"}]

▼ 0: {name: "user2", engagement: 0.709488, excitement: 0.284114, stress: 0.331528, relaxation: 0.4144, interest: 0.430185, focus: 0.493005, url: "localhost"}

▼ 1: {name: "user2", engagement: 0.240728, excitement: 0.27449, stress: 0.223234, relaxation: 0.179478, interest: 0.254299, focus: 0.233475, url: "localhost"}



human skin was electrically active. He immersed the limb in a current flowed between a limb with muscles contracted and a limb with muscles relaxed. [6] Thirty years later, in 1878 in S

DevTools - chrome-extension://ceenajadnaglochnepeocb/poamocmne/poapup.html

Elements Recorder Performance insights Network 745 2

Filter ☐ Invert ☐ Hide data URLs

All Fetch/XHR JS CSS Img Media Font Doc WS Wasm Manifest Other ☐ Has blocked cookies

☐ Blocked Requests ☐ 3rd-party requests

10000 ms 20000 ms 30000 ms 40000 ms 50000 ms 60000 ms 70000 ms

Name Headers Preview Response Initiator Timing Cookies

☐ record

```
{isSuccess: true, ...}
  errorMessage: []
  isSuccess: true
  result: [{id: 44, name: "user2", rating: 0, engagement: 0.511757, ...},
    {id: 45, name: "user2", rating: 0, engagement: 0.450313, ...},
    {id: 46, name: "user2", rating: 0, engagement: 0.511757, ...},
    {id: 47, name: "user2", rating: 0, engagement: 0.450313, ...},
    {id: 48, name: "user2", rating: 0, engagement: 0.511757, ...},
    {id: 49, name: "user2", rating: 0, engagement: 0.450313, ...},
    {id: 50, name: "user2", rating: 0, engagement: 0.511757, ...},
    {id: 51, name: "user2", rating: 0, engagement: 0.450313, ...},
    {id: 52, name: "user2", rating: 0, engagement: 0.511757, ...},
    {id: 53, name: "user2", rating: 0, engagement: 0.450313, ...},
    {id: 54, name: "user2", rating: 0, engagement: 0.511757, ...},
    {id: 55, name: "user2", rating: 0, engagement: 0.450313, ...},
    {id: 56, name: "user2", rating: 0, engagement: 0.338436, ...},
    {id: 57, name: "user2", rating: 0, engagement: 0.348721, ...},
    {id: 58, name: "user2", rating: 0, engagement: 0.173859, ...},
    {id: 59, name: "user2", rating: 0, engagement: 0.293369, ...},
    {id: 60, name: "user2", rating: 0, engagement: 0.710022, ...},
    {id: 61, name: "user2", rating: 0, engagement: 0.682577, ...},
    {id: 62, name: "user2", rating: 0, engagement: 0.675376, ...},
    {id: 63, name: "user2", rating: 0, engagement: 0.571366, ...},
    {id: 64, name: "user2", rating: 0, engagement: 0.666871, ...}
  ]
}
```

2 requests 21.7 kB transferred

Console What's New Issues

Highlights from the Chrome 113 update

Override HTTP response headers in

userRoadData.csv Show all

```
1
2 44,0.511757,0.199239,0.199239,0.330998,0.478053,0.238687,null,localhost,0001-01-01T00:00:00
3 45,0.450313,0.210874,0.210874,0.365409,0.49378,0.423821,null,localhost,0001-01-01T00:00:00
4 46,0.511757,0.199239,0.199239,0.330998,0.478053,0.238687,null,localhost,0001-01-01T00:00:00
5 47,0.450313,0.210874,0.210874,0.365409,0.49378,0.423821,null,localhost,0001-01-01T00:00:00
6 48,0.511757,0.199239,0.199239,0.330998,0.478053,0.238687,null,localhost,0001-01-01T00:00:00
7 49,0.450313,0.210874,0.210874,0.365409,0.49378,0.423821,null,localhost,0001-01-01T00:00:00
8 50,0.511757,0.199239,0.199239,0.330998,0.478053,0.238687,null,localhost,0001-01-01T00:00:00
9 51,0.450313,0.210874,0.210874,0.365409,0.49378,0.423821,null,localhost,0001-01-01T00:00:00
10 52,0.511757,0.199239,0.199239,0.330998,0.478053,0.238687,null,localhost,0001-01-01T00:00:00
11 53,0.450313,0.210874,0.210874,0.365409,0.49378,0.423821,null,localhost,0001-01-01T00:00:00
12 54,0.511757,0.199239,0.199239,0.330998,0.478053,0.238687,null,localhost,0001-01-01T00:00:00
13 55,0.450313,0.210874,0.210874,0.365409,0.49378,0.423821,null,localhost,0001-01-01T00:00:00
14 56,0.330436,0.416739,0.416739,0.409604,0.697385,0.095158,null,localhost,0001-01-01T00:00:00
15 57,0.348721,0.43162,0.43162,0.571477,0.606993,0.012611,null,localhost,0001-01-01T00:00:00
16 58,0.173859,0.122603,0.122603,0.374888,0.466933,0.022948,null,localhost,0001-01-01T00:00:00
17 59,0.293369,0.260897,0.260897,0.398187,0.459338,0.045654,null,localhost,0001-01-01T00:00:00
18 60,0.710022,0.576853,0.576853,0.597034,0.375312,0.202838,null,localhost,0001-01-01T00:00:00
```

Azure Data Studio File Edit View Window Help

SQLQuery_1 - mentalapi.database.windows.net.mentalapi (saadmin)

Welcome mentalapi.database.windows.net.mentalapi SQLQuery_1 - mental...admin) X SQLQuery_2 - mental...admin)

Run Cancel Disconnect Change Connection mentalapi Estimated Plan Enable Actual Plan Enable SQLCMD Export as Notebook

```

1 SELECT TOP (1000) [Id]
2     , [Name]
3     , [Rating]
4     , [Engagement]
5     , [Excitement]
6     , [Stress]
7     , [Relaxation]
8     , [Interest]
9     , [Focus]
10    , [Url]
11    , [Screenshot]
12    , [Date]

```

Results Messages

	Id	Name	Rating	Engagement	Excitement	Stress	Relaxation	Interest	Focus	Url	Screenshot	Date
9	368	user2	0	0,169666	0,144721	0,231963	0,11751	0,424111	0,146369			0001-4
10	369	user2	0	0,137832	0,167417	0,233406	0,132889	0,43631	0,07329			0001-4
11	370	user2	0	0	0	0	0	0	0	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
12	371	user2	0	0	0	0	0	0	0	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
13	372	user2	0	0,715838	0,205028	0,365784	0,421557	0,494936	0,516555	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
14	373	user2	0	0,469385	0,498245	0,493113	0,551166	0,550124	0,37729	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
15	374	user2	0	0,646979	0,713939	0,41293	0,434064	0,495224	0,5617	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
16	375	user2	0	0,630468	0,393141	0,38384	0,408921	0,460409	0,591261	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
17	376	user2	0	0,592997	0,235211	0,39806	0,412705	0,471805	0,467372	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
18	377	user2	0	0,504471	0,332451	0,300691	0,346026	0,540614	0,309841	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
19	378	user2	0	0,517188	0,397777	0,320276	0,33638	0,480305	0,294002	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
20	379	user2	0	0,500879	0,203085	0,274869	0,304545	0,468501	0,314883	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
21	380	user2	0	0,50077	0,417278	0,383585	0,452125	0,554597	0,309707	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
22	381	user2	0	0,457239	0,296883	0,332148	0,377111	0,50687	0,244384	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
23	382	user2	0	0,403107	0,302896	0,291229	0,313338	0,448016	0,202878	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4
24	383	user2	0	0,385461	0,302975	0,311744	0,311488	0,48506	0,248093	https://en.wikipedia.org/_	data:image/jpeg;base64,/9...	0001-4

Рисунок 4 – Приклад зібраних даних.

Висновки

Для збору даних був використаний EEG Emotiv Insight. Вибір був оснований на тому що, по опису виробника:

- 1) Наявність EEG сенсорів, можливість отримання як не оброблених EEG сигналів, так і оброблених (дані продуктивності, ментальні команди, оброблені сигнали лицевих м'язів - певні вирази обличчя)
- 2) Зручність використання Emotiv Insight - це бездротовий прилад, з терміном роботи від акумулятора - до 20 годин.
- 3) Ціновий діапазон. Вартість приладу - 500\$, що є середньо доступною ціною на ринку подібних приладів
- 4) API - є можливість використовувати різні мови програмування - Python, C++, JavaScript

Висновки

- 1) Погана якість сигналу.
- 2) Під час користування додатком, датчики постійно потрібно змочувати, бо інакше втрачається сигнал або втрачається зв'язок. Це **вплинуло на розробку архітектури додатку.**
- 3) Для отримання EEG даних потрібна окрема ліцензія.
- 4) Для отримання ментальних команд потрібен окремий запит в службу підтримки.
- 5) Слабка підтримка з боку ком'юніті, мало прикладів роботи з API.
- 6) Для користування додатком потрібен clientId.

Збір даних, які поєднують в собі інформацію про досвід користувача разом з даними про ментальні стани та управління за допомогою ментальних команд, відкриває широкі перспективи і можливості. Для розкриття цих можливостей **необхідно провести додаткові дослідження та вдосконалити прототип.**

Дякую за увагу