NEUROMOTION

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What is *NeuroMotion*?

A tool that captures EEG motor imagery signals and uses them to display the user's intended movement

Scenario

Jane

Age: 46
Gender: Female
Location: Vancouver, AB

Likes:
-Basketball
-Hiking
-Dogs

Dislikes:
-Broccoli
-Planes

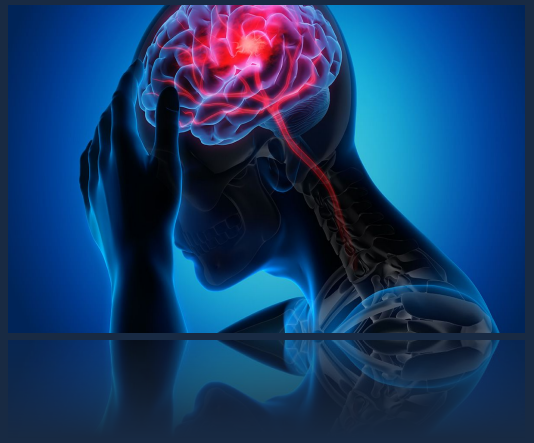
Bio

Jane has spent most of her life being a Veterinarian. A year ago, she had a ischemic stroke causing her to lose some of her vital motor movement functions. Despite the physical limitations she has found happiness in watching soap operas and reading.

Millions of Others Like Jane

- Every year, ***≈15 million*** people suffer from strokes worldwide
  (+ From which 5million become permanently disabled) [1]

- Not only strokes:
  - Traumatic brain injury (TBI) → 49 million in 2019 [2]
  - Spinal cord injury (SCI) → 15 million as of 2024 [3]
  - Amyotrophic lateral sclerosis (ALS) → 1 in 400 lifetime risk [4]
  - Ataxia → 1 in 50,000 people [5]



NEUROMOTION PROCESS

1.Read

- Capture raw EEG's using OpenBCI headset
- Apply filtering and preprocessing to the EEG data

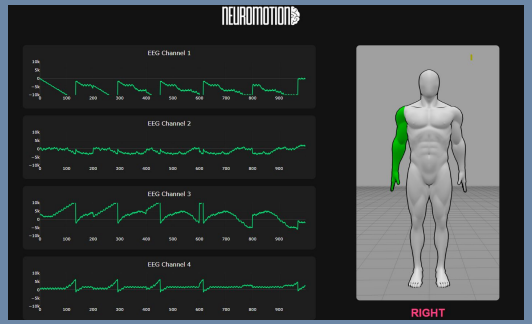
2.Predict

- Feed processed data into machine learning model
- Classifies/predicts imagined movement

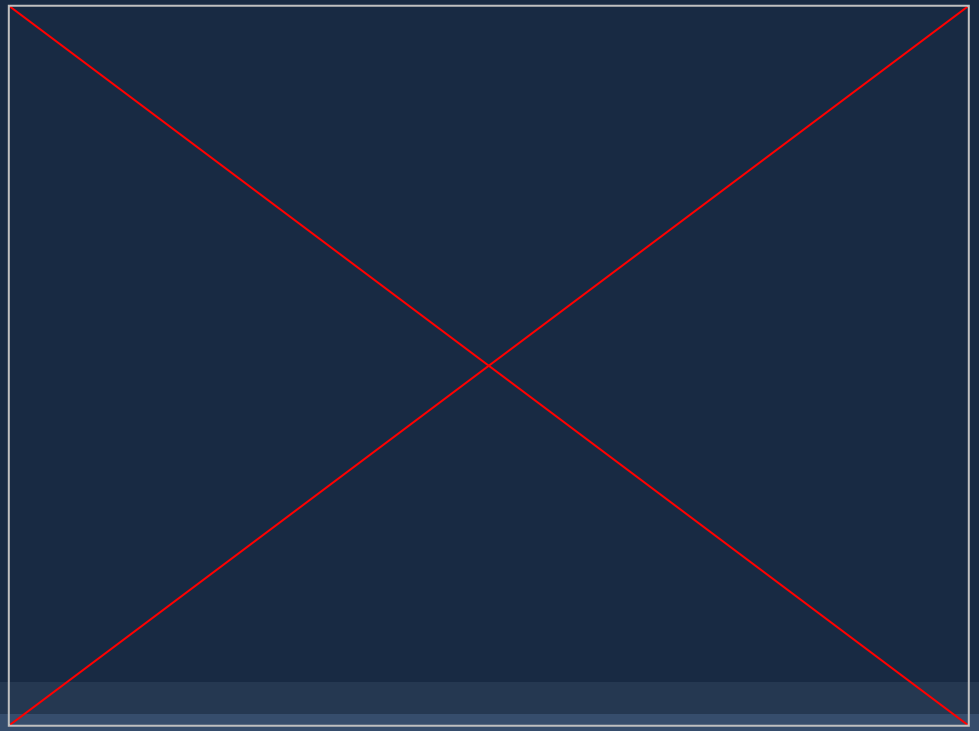
```
    optimizer,
    max_lr=3e-3,
    steps_per_epoch=max(1, int(np.ceil(len(Xtr)/64))),
    epochs=80,  # train a bit longer, still with early stop
    pct_start=0.25
    )

    # ---------- Train ---------
    best_acc = 0.0
    best_state = None
    patience, patience_ctr = 12, 0
    max_epochs = 60
    t0 = time.time()

    for epoch in range(1, max_epochs + 1):
        tr_loss, tr_acc = train_one_epoch(model, optimizer, loss_fn, Xtr, y_tr,
                                          batch_size=64, device=device, scheduler=scheduler)
        va_loss, va_acc = eval_epoch(model, loss_fn, Xva, y_val,
                                     batch_size=256, device=device)
        scheduler.step()

        print(f"[{epoch:03d}] tr_loss={tr_loss:.4f} tr_acc={tr_acc:.4f} | "
              f"val_loss={va_loss:.4f} val_acc={va_acc:.4f}", flush=True)

        improved = va_acc > best_acc + 1e-4
        if improved:
            best_acc = va_acc
            best_state = {k: v.detach().cpu().clone() for k, v in model.state_dict().items()}
            patience_ctr = 0
        else:
            patience_ctr += 1
            if patience_ctr >= patience:
                print("[trainer-4ch] early stop", flush=True)
                break

    print(f"[trainer-4ch] done in {time.time()-t0:.1f}s | best val_acc={best_acc:.4f}", flush=True)
```

3.Display

- Display intended movement on Graphical User Interface (GUI) for user feedback



Video Demo



Further Applications

Assistive Technology

The system can help them interact with devices or control assistive technologies (like wheelchairs or prosthetics) through thought-based commands.

Neurorehabilitation and FES

Those recovering from strokes, spinal cord injuries, or neuromuscular disorders can use EEG motor imagery feedback for rehabilitation and brain retraining.

Researchers and Clinicians

Gain affordable access to real-time brain signal tracking for studying motor cortex activity and brain–computer interface (BCI) applications.

Sources

[1]H. Yang, J. Wan, Y. Jin, X. Yu, and Y. Fang, “EEG- and EMG-Driven Poststroke Rehabilitation: A Review,” *IEEE Sensors Journal*, vol. 22, no. 24, pp. 23649–23660, Dec. 2022, doi: https://doi.org/10.1109/JSEN.2022.3220930.

[2]B. Guan, D. Anderson, L. Chen, S. Feng, and H. Zhou, “Global, regional and national burden of traumatic brain injury and spinal cord injury, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019,” *BMJ Open*, vol. 13, no. 10, pp. e075049–e075049, Oct. 2023, doi: https://doi.org/10.1136/bmjopen-2023-075049.

[3]World Health Organization, “Spinal Cord Injury,” *World Health Organization*, Apr. 16, 2024. https://www.who.int/news-room/fact-sheets/detail/spinal-cord-injury

[4]“ALS Therapy Development Institute,” *ALS Therapy Development Institute*, 2017. https://www.als.net/what-is-als/?gad_source=1&gad_campaignid=20278958829&gbraid=0AAAAAD1Cxd-A7uWSnRnbJNZLPJNe9vlH6&gclid=CjwKCAiAt8bIBhBpEiwAzH1w6Z58zAOSWMOVwO4Nat906EZsdE7URN-0ZwI6ACsszyVmwUmmuVo-mBoCKH4QAvD_BwE (accessed Nov. 10, 2025).

[5] NHS Choices, “Types - Ataxia,” *NHS*, 2019. https://www.nhs.uk/conditions/ataxia/symptoms/