[Idea 3: EOG based interface]

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HCI Project

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Idea of Project:

If we have an **EOG signal**, it is a signal of eye movements up, down, right, left, or blink and we want to use it to set up specific tasks so that The UI should enable the user to choose whether to sleep, eat, drink water, or go to the bathroom by UI Design.

Dataset:

- We have 278 files.
- we have 5 Classes:
  - Yukari --> Up
  - Asagi --> Down
  - Sag --> Right
  - Sol --> Left
  - Kirp --> Blink
- We Use 100 File After Preprocessing.

1-Data preparation and Preprocessing:

Data Preparation:

1) The Signals is a reading manual Use **ReadSignal ()** Function.
2) do preprocessing on this Signals.
3) Do Feature Extraction Using 5 Ways.
4) Concatenate Horizontal with Vertical Data in one Signal.
5) The dataset is split into training and testing sets using the train_test_split function from the sklearn library.
6) The training data is used to fit the model and the testing data is used to evaluate the model's performance.

Preprocessing:

1) **Filter Signals** by reading files that contain only h and v in their name with same number of signal and neglected anything else and Single Signal.
2) use a **band pass filter** With "lowCutoff=.5" & "highCutoff=20".
3) **Down Sampling** to half Using **Resample ()** Function.
4) **Normalization** Signals Manual Using **Z-Score**.
5) **Remove DC Component** in Signal by Subtract Signal **Median**.
6) **Label Encoder** for Classes:
    - Yukari --> Up --> 4.
    - Asagi --> Down --> 0.
    - Sag --> Right --> 2.
    - Sol --> Left --> 3.
    - Kirp --> Blink --> 1.

2- Feature extraction methods:

We Use 5 Ways to Feature Extraction:

In Frequency Domain Features:

1) Compute Statistical features from wavelet coefficients.
2) Power Spectral Density (PSD).

In Time Domain Features:

1) Compute Morphological features from filtered signals:
    a. Max peak values Features: Firstly, find all peaks in each signal then find the max peak value.
    b. Area under curve Features: it's meant the integration of the function of curve.
2) Auto Regression Coefficients.

3- Classification Models and parameters:

- **K-Nearest Neighbors (KNN):**
    - The parameters used for the KNeighborsClassifier classifier are **k = 5** # Number of nearest neighbors to consider
- **Support Vector Machine Classifier (SVM):**
    - The parameters used for the SVC classifier are **(kernel='linear', C=1.0)**
- **Random Forest:**
    - The parameters used for the SVC classifier are **n_trees = 100** # Number of trees in the forest

4- Classification results:

1) KNN:

#	Feature extraction	Accuracy
1	Compute Statistical features from wavelet coefficients	45 ~ 70 %
2	Power Spectral Density (PSD)	20 ~ 35 %
3	**Compute Morphological features from filtered signals Using Max peak values**	75 ~ 100 %
4	Compute Morphological features from filtered signals Using Area under curve	30 ~ 65 %
5	Auto Regression Coefficients	50 ~ 75 %

2) Support Vector Machine:

#	Feature extraction	Accuracy
1	Compute Statistical features from wavelet coefficients	50 ~ 80 %
2	Power Spectral Density (PSD)	30 ~ 55 %
3	**Compute Morphological features from filtered signals Using Max peak values**	70 ~ 100 %
4	Compute Morphological features from filtered signals Using Area under curve	40 ~ 70 %
5	Auto Regression Coefficients	45 ~ 80 %

3) Random Forest:

#	Feature extraction	Accuracy
1	**Compute Statistical features from wavelet coefficients ("The Best Accuracy over All")**	**80 ~ 100 %**
2	Power Spectral Density (PSD)	20 ~ 45 %
3	Compute Morphological features from filtered signals Using Max peak values	70 ~ 95 %
4	Compute Morphological features from filtered signals Using Area under curve	30 ~ 65 %
5	Auto Regression Coefficients	80 ~ 95 %

5- UI:

Will put After Finish Design inshallah.

Thank You :)