EOG based Calculator

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1) Data Preparation and Preprocessing:

1- band bass filter using low cut 0.5 and high cut 20 and filter order 5

2- down sample the signals to 50 sample/second
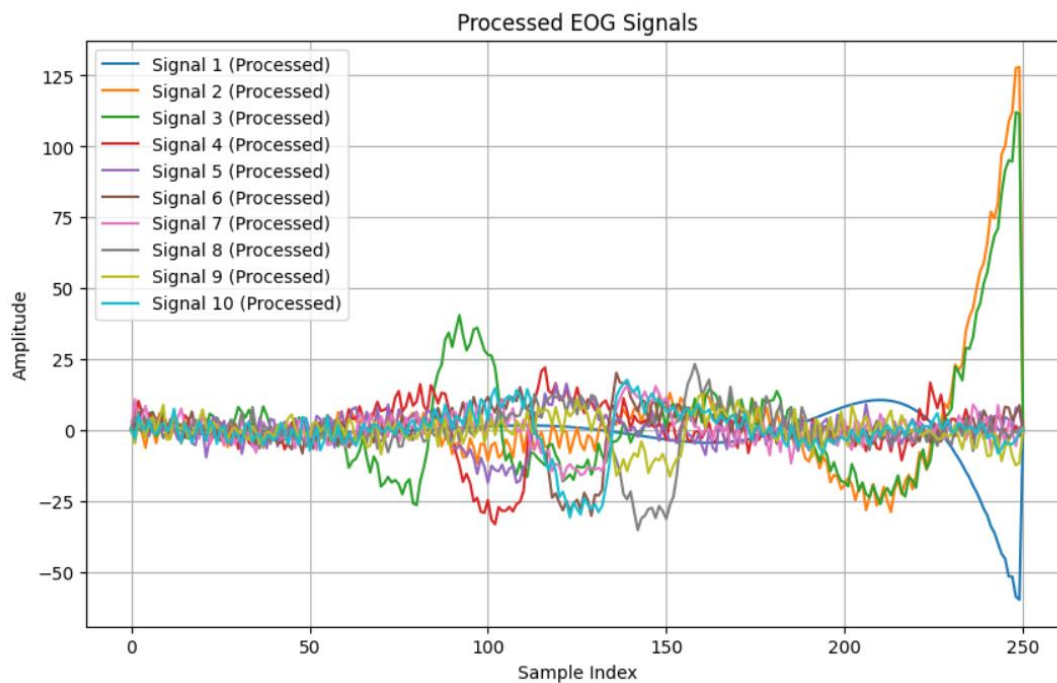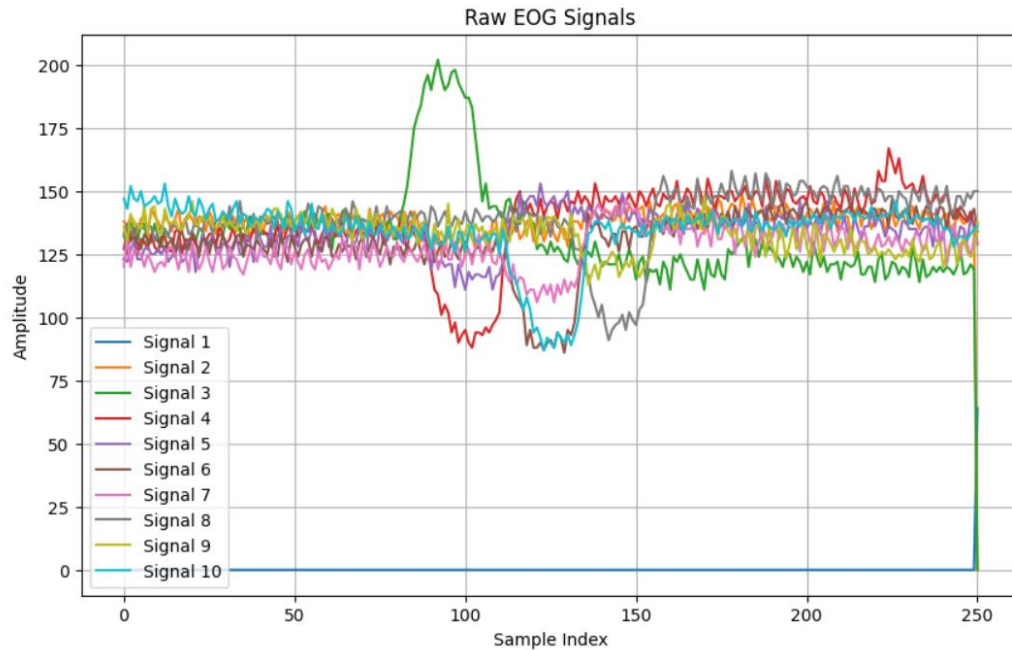
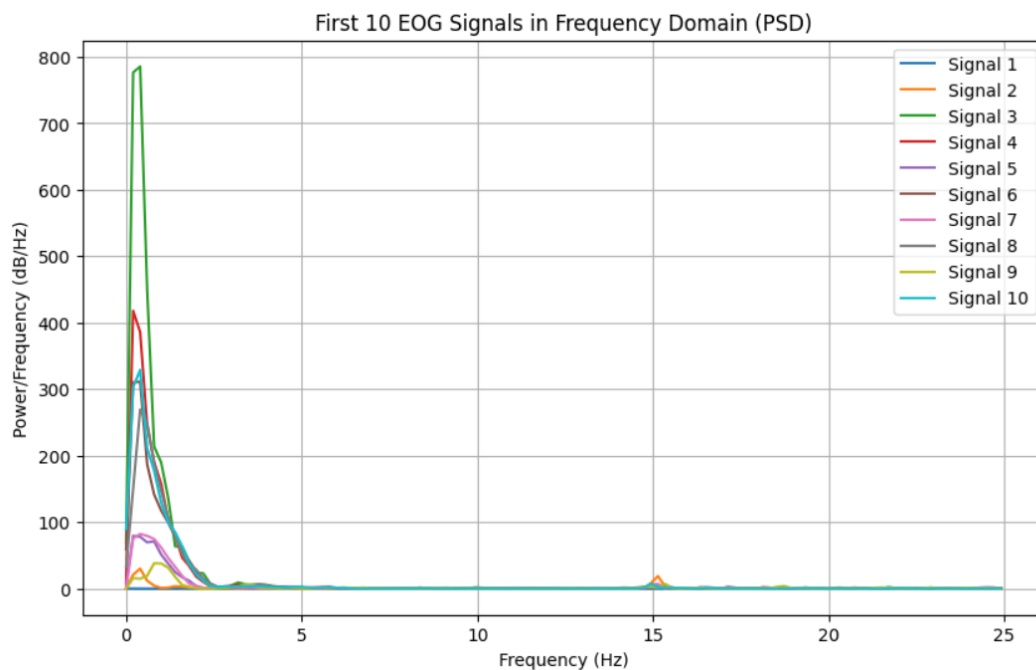## 2) Feature Extraction Methods:
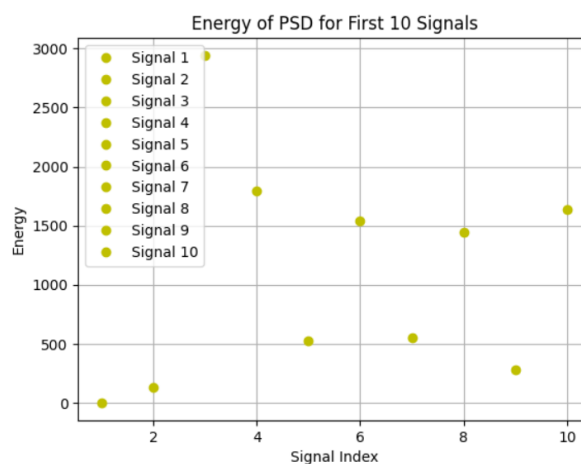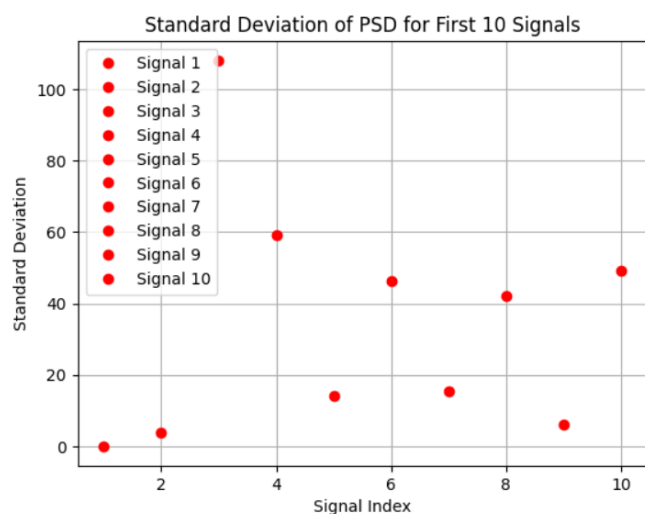
Using the signal in frequency domain PSD , Fs =50

 The features is :

1- mean for horizontal and vertical signals

2- variance for horizontal and vertical signals

3- Energy for horizontal and vertical signals

4- standard deviation for horizontal and vertical signals

 Then we contacted the features of horizontal and vertical channels to get the data in this shape 100×9

Which is 100 row and 9 columns: [variance_h , mean_h , energy_h , S_D_h, variance_v , mean_v , energy_v , S_D_v , lable]

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Variance of PSD for First 10 Signals

Mean PSD for First 10 Signals

Standard Deviation of PSD for First 10 Signals

Energy of PSD for First 10 Signals
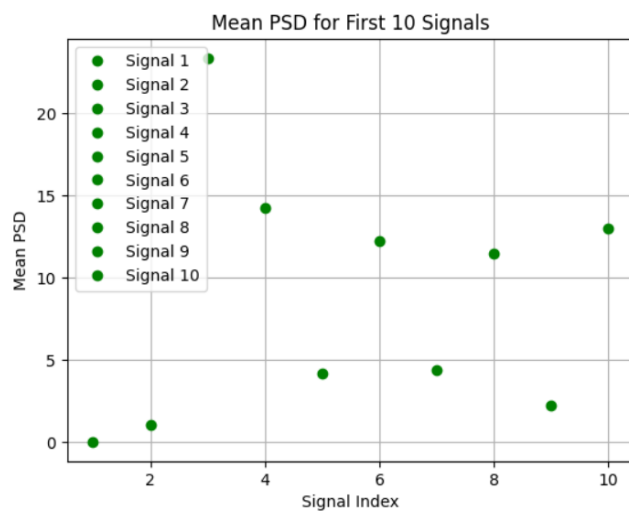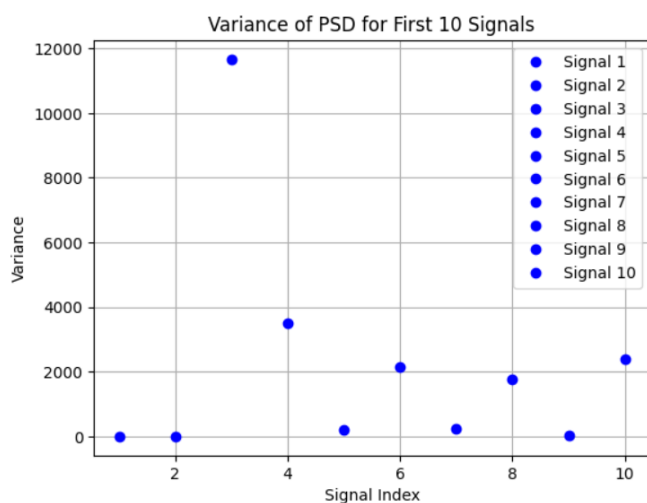
	var_h	mean_h	S_D_h	energy_h	var_v	mean_v	S_D_v	energy_v \
0	5.672	0.385	2.382	48.537	203.344	2.604	14.260	328.053
1	1294.656	8.972	35.981	1130.481	626.284	6.618	25.026	833.814
2	74.712	2.431	8.644	306.303	434.017	5.923	20.833	746.282
3	97.854	2.654	9.892	334.372	624.363	6.714	24.987	845.980
4	31.145	1.767	5.581	222.661	542.956	6.282	23.301	791.527
5	21.882	1.503	4.678	189.402	349.162	5.376	18.686	677.343
6	40.374	1.954	6.354	246.260	231.154	4.501	15.204	567.121
7	29.719	1.574	5.452	198.384	378.284	5.664	19.450	713.690
8	13.684	1.220	3.699	153.663	455.308	5.911	21.338	744.727
9	38.212	1.786	6.182	225.056	156.949	3.830	12.528	482.618

```
   label_y
0     Edit
1    asagi
2    asagi
3    asagi
4    asagi
5    asagi
6    asagi
7    asagi
8    asagi
9    asagi
```

3) Classifier Used and Parameters:

Classifier:

Support Vector Machine (SVM)

Parameters:

Tuned hyperparameters using a parameter grid to optimize performance.

C (Regularization Parameter):

Values tested: [0.1, 1, 10, 100]

Best parameter: 100

Gamma (Kernel Coefficient):

Values tested: [0.1, 0.01, 0.001]

Best parameter: 0.1

Kernel:

Kernels tested: 'linear', 'rbf', 'poly', 'sigmoid'

Best parameter: 'linear'

4) Classification Results:

Classifier	Accuracy	Precision	Recall	F1 Score
SVM	90%	0.9	o.88	0.68
Decision Tree	65%	.65	.66	.63

```
Best Hyperparameters: {'C': 100, 'gamma': 0.1, 'kernel': 'linear'}
Accuracy: 0.9

Classification Report:
              precision    recall  f1-score   support

       asagi       1.00      0.88      0.93         8
        kirp       1.00      1.00      1.00         4
         sag       1.00      0.50      0.67         2
         sol       0.75      1.00      0.86         3
      yukari       0.75      1.00      0.86         3

    accuracy                           0.90        20
   macro avg       0.90      0.88      0.86        20
weighted avg       0.93      0.90      0.90        20
```

```
Best Hyperparameters: {'C': 100, 'gamma': 0.1, 'kernel': 'sigmoid'}
Accuracy: 0.45

Classification Report:
              precision    recall  f1-score   support

       asagi       0.50      0.80      0.62         5
        kirp       0.75      0.60      0.67         5
         sag       0.33      0.33      0.33         3
         sol       0.33      0.25      0.29         4
      yukari       0.00      0.00      0.00         3

    accuracy                           0.45        20
   macro avg       0.38      0.40      0.38        20
weighted avg       0.43      0.45      0.43        20
```

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Best Hyperparameters: {'criterion': 'gini', 'max_depth': None, 'min_samples_leaf': 2, 'min_samples_split': 10}
Accuracy: 0.65

Classification Report:
              precision    recall  f1-score   support

       asagi       0.75      0.60      0.67         5
        kirp       1.00      0.80      0.89         5
         sag       0.50      1.00      0.67         3
         sol       0.50      0.25      0.33         4
      yukari       0.50      0.67      0.57         3

    accuracy                           0.65        20
   macro avg       0.65      0.66      0.63        20
weighted avg       0.69      0.65      0.64        20
```

5) Screenshots for Running Interface: