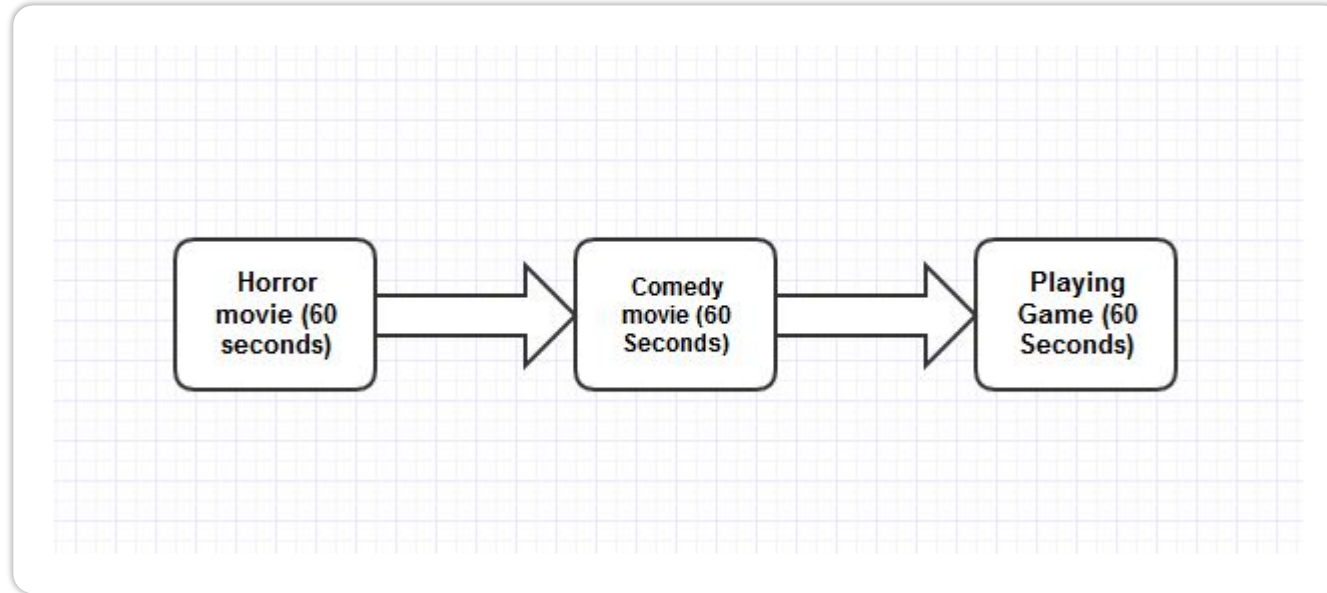


Emotion State Classification of a Human Subject Using Single Channel EEG Data

Data Acquisition and Feature Extraction

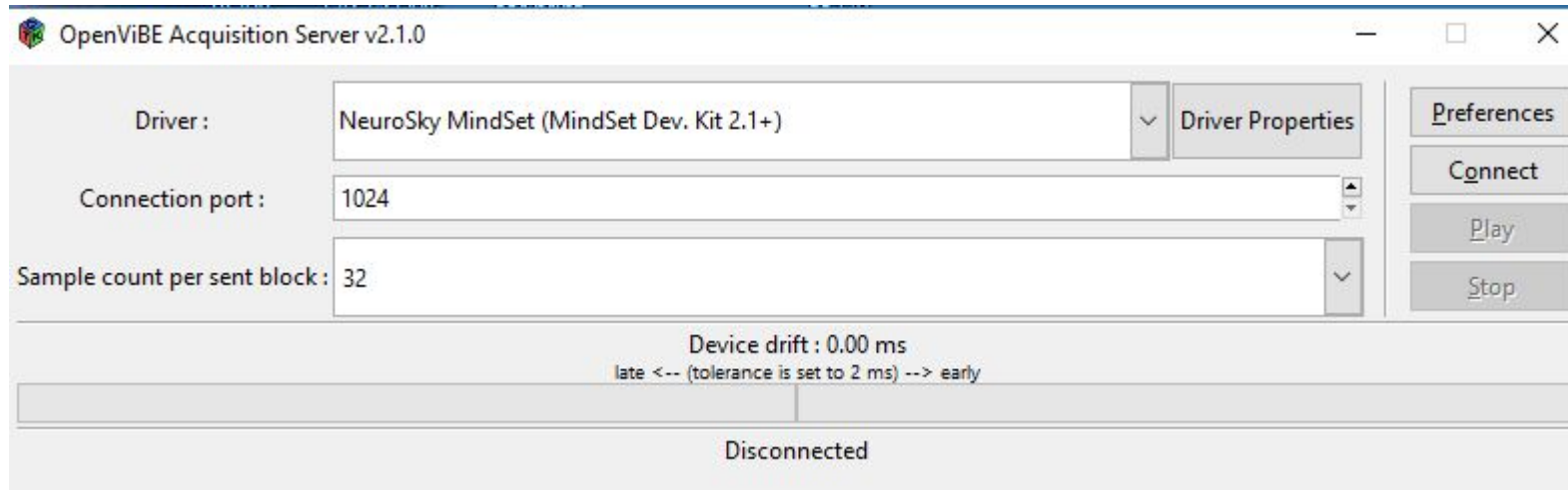
- The data from 5 subjects were collected. We decided to use a horror movie during the first 60 seconds. The horror movie is followed by a comedy movie (60 seconds) and then the subject was asked to play some game (60 seconds). The process of our experiment is depicted below:



- Afterward, each input time-series was divided into a sequence of discrete segments of 6 seconds and the mean value was calculated for each frequency band (Alpha, Low-beta and High-beta) during each of the time-segments.

Data Acquisition using OpenVibe

STEP-1



STEP-2

Device configuration

Neurosky Mindset

Identifier :

Age :

Gender :

Sampling frequency :

COM Port :

☒ ESense (Meditation/Attention)

☒ Power (8 channels)

☒ Blinks (As OVTK_GDF_Eye_Blink stimulation)

☒ Blink Strength (1 channel with spikes)

STEP-3

OpenViBE Acquisition Server v2.1.0

Driver :

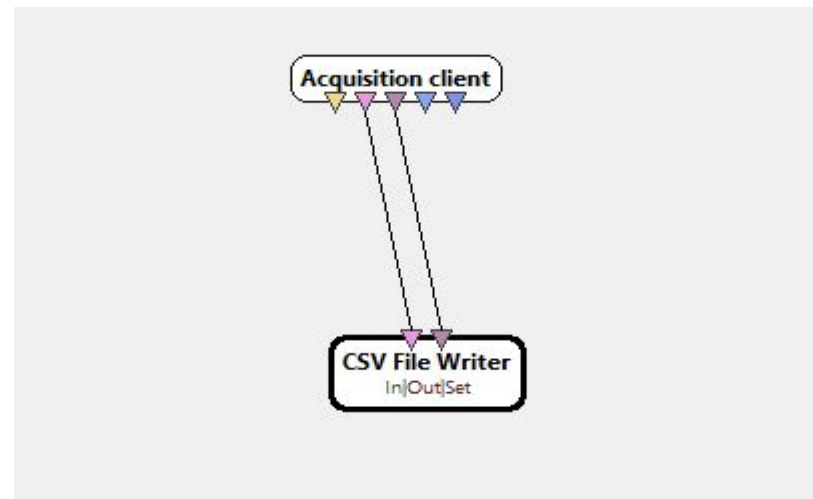
Connection port :

Sample count per sent block :

Device drift is too high : -475.42 ms
late <-- (tolerance is set to 2 ms) --> early

Receiving...
0 clients connected

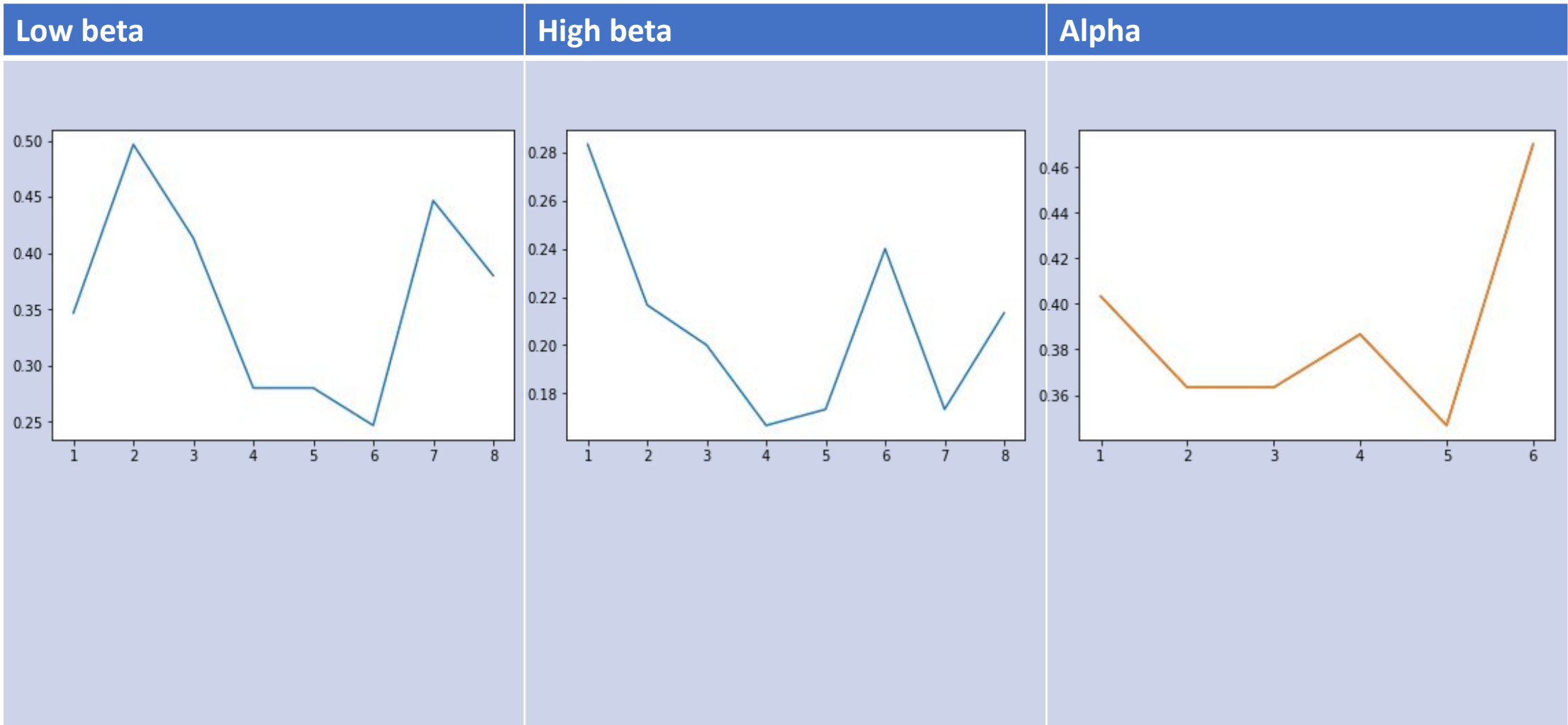
STEP-4



Average Accuracy Score after 5 Fold Cross Validation(KNN) Considering All Subjects

K-Value	Low beta	High beta	Alpha
1	0.536666666666666	0.716666666	0.596666666666
2	0.553333333333333	0.7833333333	0.636666666
3	0.619999999999999	0.800000000000000	0.636666666666
4	0.62	0.833333333333333	0.6133333333333
5	0.553333333333333	0.8266666666	0.6533333333333
6	0.736666666666666	0.760000000000000	0.5300000000000

Parameter Tuning with Cross Validation(Misclassification Error vs K Plot)

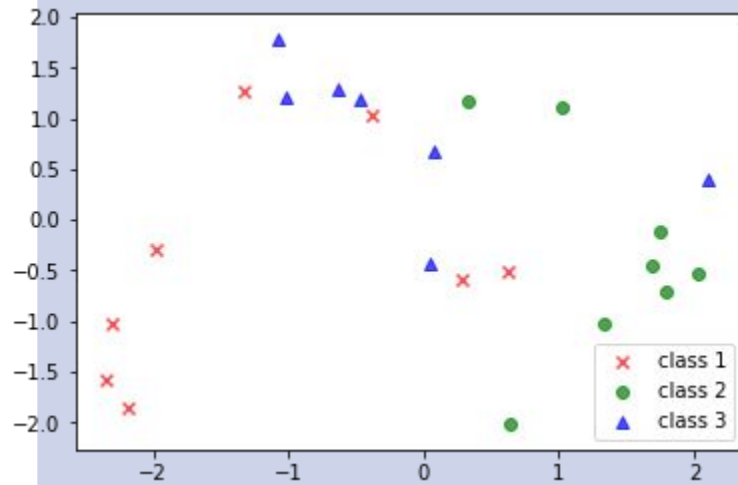


Average Accuracy Score after 5 Fold Cross Validation(KNN) for Each Subject

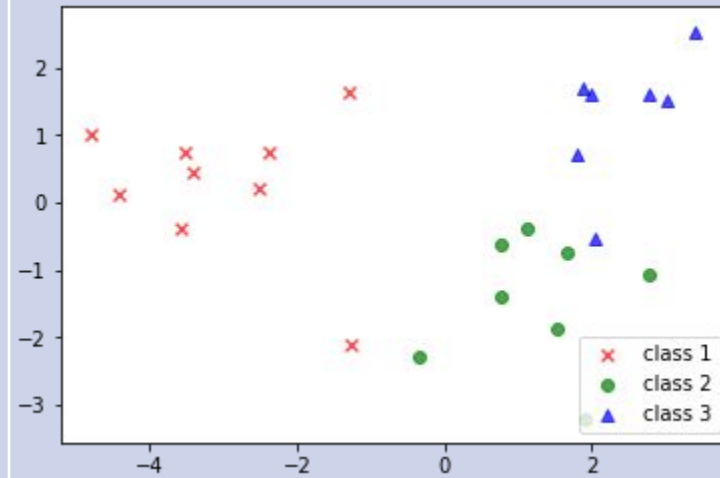
K-value	Sub1	Sub2	Sub3	Sub4	Sub5
1	0.5666666666666666	0.3333333333333333	0.5999999999999999	0.4666666666666666	0.6333333333333333
2	0.5	0.4333333333333333	0.5666666666666666	0.5	0.5333333333333333
3	0.4333333333333333	0.3666666666666666	0.5666666666666666	0.3999999999999999	0.5666666666666666
4	0.4666666666666666	0.2999999999999999	0.5999999999999999	0.6666666666666666	0.6333333333333333
5	0.5666666666666666	0.3999999999999999	0.5999999999999999	0.5666666666666666	0.5666666666666666
6	0.5	0.5	0.5999999999999999	0.5999999999999999	0.4999999999999999

LDA Scatter Plot

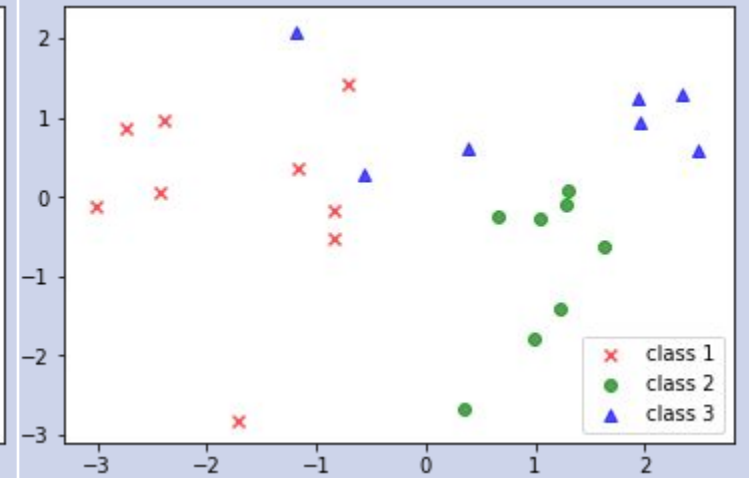
Low beta



High beta



Alpha



Average Accuracy Score after 5 Fold Cross Validation(SVM, kernel=linear)

Low beta	High beta	Alpha
0.6866666666	0.70333333333333	0.76666666666666

Sub1	Sub2	Sub3	Sub4	Sub5
0.3666666666	0.400000000000	0.5666666666	0.4333333333333333	0.7666666666666666

ANOVA Test(Alpha, Low-Beta, High-Beta)

Sum of Squares(SS) between Class	Mean Square(MS) between Class	P-value
3.74E+10	1.87E+10	3E-08

Sum of Squares(SS) between Class	Mean Square(MS) between Class	P-value
6.4E+8	3.2E+8	0.0017612

Sum of Squares(SS) between Class	Mean Square(MS) between Class	P-value
2.36E+10	1.18E+10	6.2E-16

Conclusion

- For all subjects except 'Subject 5' KNN (k-nearest neighbours) gives better accuracy than SVM (support vector machine).
- The classification result of three emotions varies in subjects due to emotional dependency of subjects.
- From the result of ANOVA Test , we can conclude that all higher frequency waves are statistically more significant than lower frequency waves present in the raw signal. Higher frequency waves like alpha, low beta and high beta all have **p-value** less than 0.01. Therefore, all of these waves were considered for classification of emotion.