



DLA Project


EEG-Based Emotion Recognition
using Simple Recurrent Units
Network and Ensemble Learning

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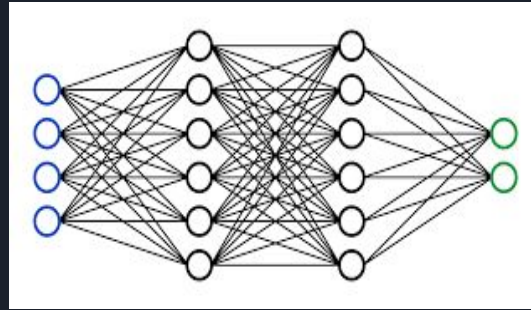
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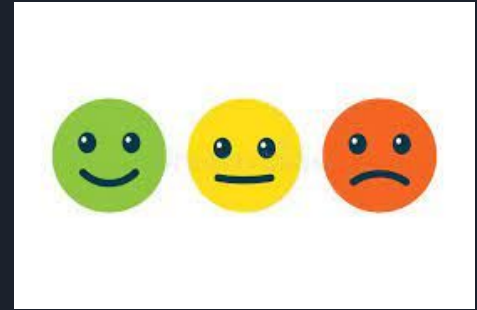
Objective: The paper aims to develop an EEG-based emotion recognition system for identification of three emotions: positive, neutral and negative



Generate EEG Signal



Process EEG Signal using NN



Predict Emotion



Dataset Used

SEED Dataset

- The SEED dataset contains EEG signals of 15 subjects when they were watching 4 minutes film clips.
- Each subject performed the experiment 3 times in intervals of 1 week.
- 15 film clips were carefully selected in each experiment to induce different types of emotion, which are positive, negative, and neutral.
- For feedback, the participants were told to report their emotional reactions to each film clip by completing the questionnaire immediately after watching each clip.



Proposed Approach

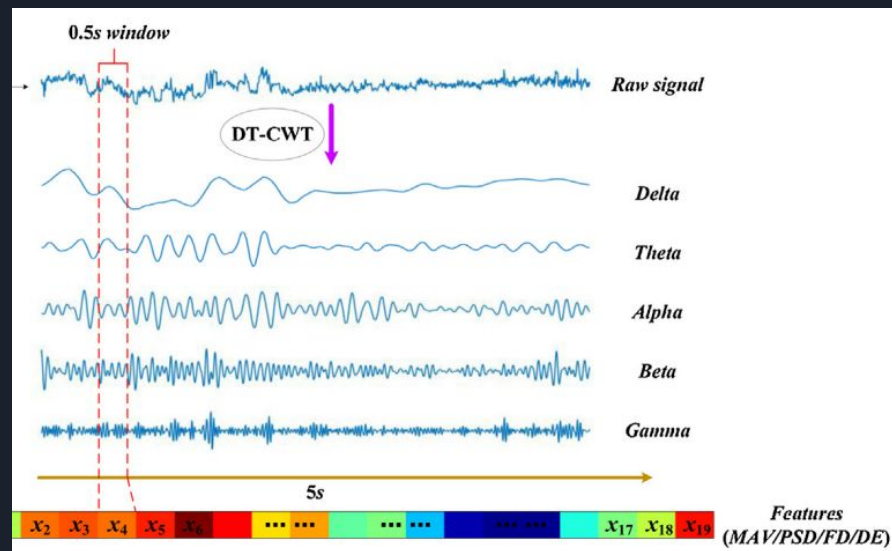
The main components of the proposed methodology are:

- Preprocessing using DT-CWT.
- Feature Extraction using decomposed EEG signal.
- Using SRUs for model building.
- Ensemble Learning.

Feature Extraction

Feature extraction methods used-

1. Time Analysis (Mean Absolute Value)
2. Frequency Analysis (Power Spectral Density)
3. Complexity Analysis(Fractal Dimension and Differential Entropy)





Training

- Each feature extraction was done on 19 intervals to generate 19 timesteps for each EEG signals.
- 62 Channels for each EEG signal act as features for the Model.
- Four feature technique are applied on each DTCWT decomposed signal, and converted to 19 sequence length.
- Training is done using within one day method.
- There are 15 sessions for 1 person per day
 - Training on first 9 sessions
 - Testing on last 6 sessions.
- Train data (19,9,62) And Test data(19,6,62)

[(timesteps,samples,features)]



Training

- SRU Model is made using Pytorch Library.
- We have used two SRU Model Architecture,

1st model with 2 SRU layers of 128 units

2nd model with 2 SRU layers with 200,100 units,Dropout layer and fully connected layer

- MAV features are trained on first model for about 200 epoch and PSD,FD,DE on 2nd model for 50-100 epochs.
- Adam optimizer is used with $lr=0.0001$ and $weight_decay=1e-5$.

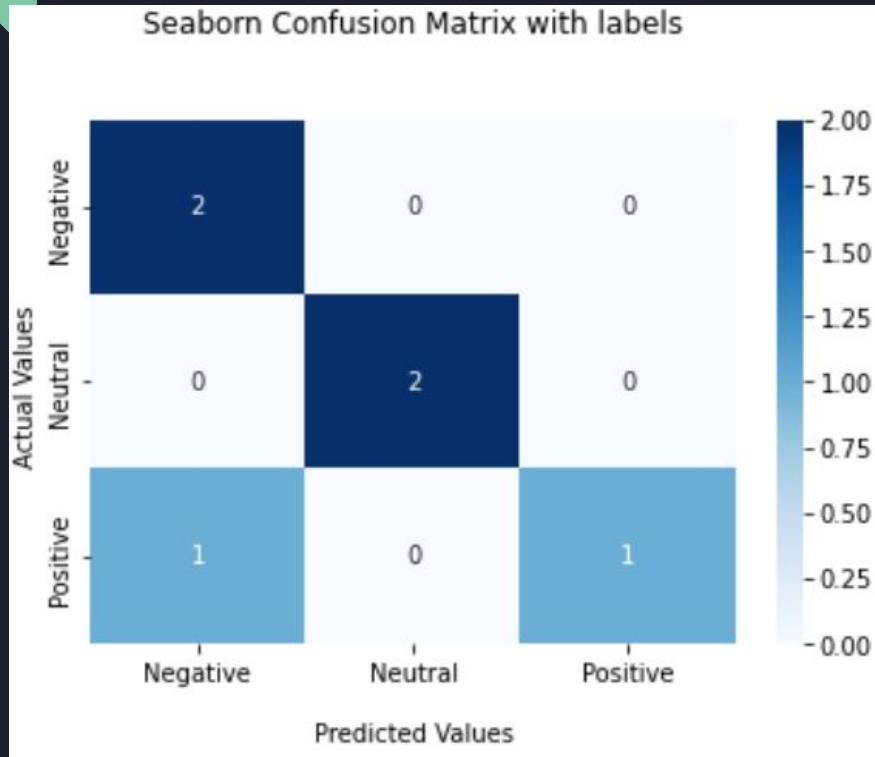
Results

Accuracies (Within one day) on 11 EEG Data

Ensemble Strategy: Select the best feature for each of the five frequency bands for ensemble

Sr No.	EEG Data	Result(Accuracy)
1	'1_20131027.mat',	0.8333,
2	'1_20131030.mat',	0.8333,
3	'1_20131107.mat',	0.5000,
4	'1_20131107.mat',	0.8333,
5	'4_20140705.mat',	0.6667,
6	'4_20140702.mat',	0.5000,
7	'4_20140621.mat',	0.5000,
8	'3_20140629.mat',	0.5000,
9	'3_20140611.mat',	0.6667,
10	'3_20140603.mat',	1.,
11	'2_20140419.mat'	0.3333

Results



Confusion Matrix for one of the person's data where accuracy of ensemble was 0.8333

(5 correct out of 6)