Music and Dementia Innovation

CS460: Foundation of Cyber-Physical Systems

G2T5
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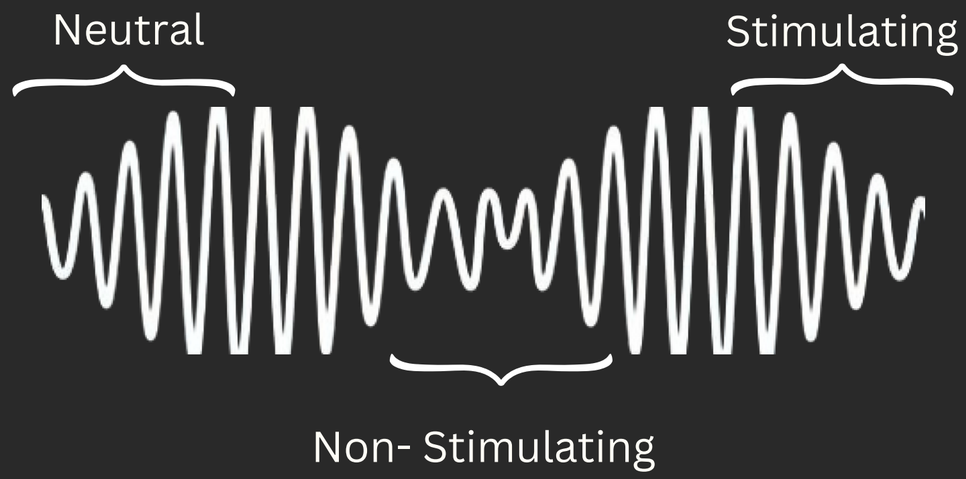
Determining the label of a song

Data Collection Methodology

OUR APPROACH TOWARDS COLLECTING DATA



IDEA:

Instead of providing a label to the song as a whole, provide a label (stimulating/ neutral/ non-stimulating) for parts of a song to account for the differences in stimulation within songs.

Data Collection Methodology

USAGE OF KEYSTROKE FUNCTION BY EMOTIVPRO 3.0

Key bindings	Value associated
Num 8	888 - Neutral
Num 9	999 - Stimulating
Num 0	666 - Non-stimulating
Letter S	200 - Start Song
Letter E	404 - End Song

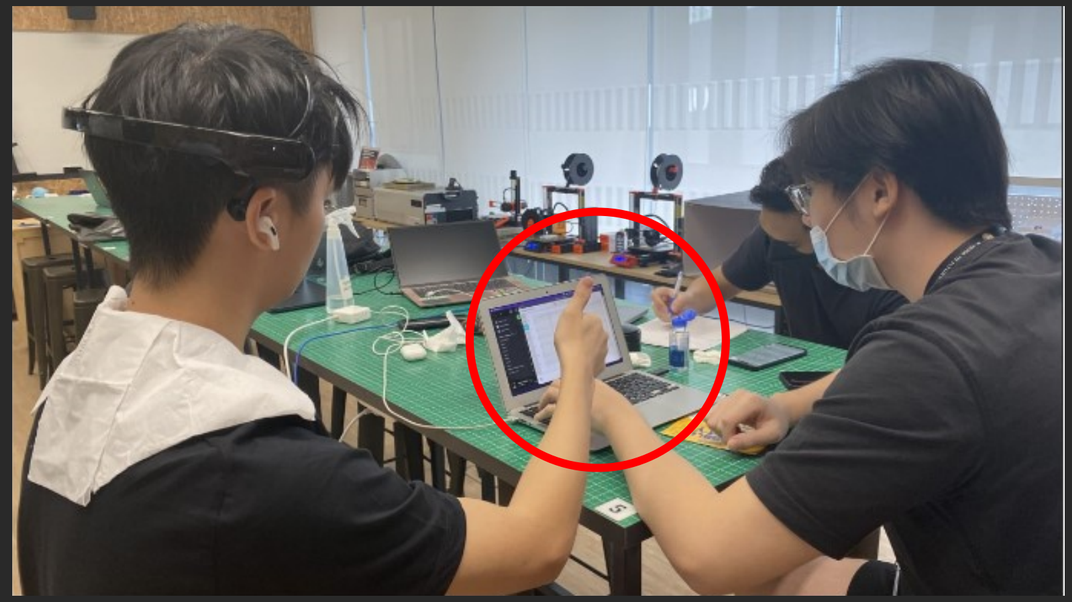
PURPOSE:

It will populate the MarkerIntValue with the Value Associated, so we can mark our dataset accurately.

Data Collection Methodology

HOW WE COLLECTED OUR DATA?

Hand Signals	Interpretation
Thumbs Up	Stimulating
Thumbs Up (45 degree to the left)	Neutral
Thumbs Down	Non-stimulating



ROLES:

1. Recorder: A person to play the music and indicate the KeyStroke Target Value
2. Subject: A person will Hand Signal according to how the interpretation of the song is

Dataset Cleaning Process

NEWLY CREATED COLUMNS IN OUR DATASET

1. EQ.OVERALL.NEW

Populating the blanks between rows within same EQ.OVERALL values

2. TARGET

Label to determine whether the part of the song is stimulating, non-stimulating, neutral

3. SONG

Tracking of rows of data that belongs to the same song.

EQ.OVERALL.New

NEWLY CREATED COLUMNS IN OUR DATASET

REASON FOR CREATION:

EQ.OVERALL measures EQ Quality which is necessary for us to determine which rows to drop, but it is only populated once every 63 rows, leaving many blank cells in between one value and the next.

Thus, with the new column, we are ensuring that each row will have a EQ.Overall.

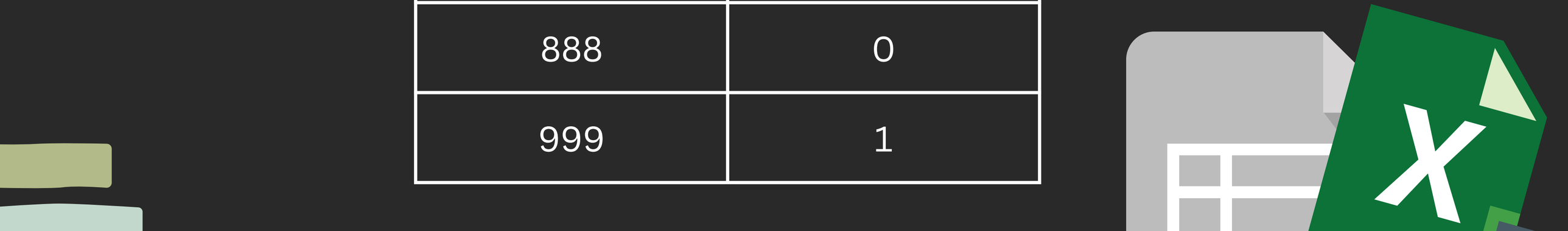
Target

NEWLY CREATED COLUMNS IN OUR DATASET

REASON FOR CREATION:

Purpose of “Target” is to know what our Subject is currently feeling about the song and give a rating of “Stimulating”, “Neutral”, “Non-Stimulating”.

MarkerValueInt	Target
666	-1
888	0
999	1



Song

NEWLY CREATED COLUMNS IN OUR DATASET

REASON FOR CREATION:

Track which rows of data belong to which song, similar to a Song ID. This will allow us to know which data row belongs to which song.

Dataset Cleaning Process

DROPPING OF DATA

1. REMOVAL OF ROWS WITH NAN VALUES

With the usage of DropNa function, this will allow us to take rows that are populated.

2. REMOVAL OF BAD QUALITY DATA

Using the "EQ.Overall.New" column created, we will drop any Quality Rate less than 90%

Model Building

Classification Algorithms

Model Building

TYPE OF AGGREGATION

1. TRAIN - TEST SPLIT

Pandas will select the row randomly until it fills up a ratio of 80% and 20% training and testing dataset.

2. MANUAL SPLIT

We use Manual split, where we select the data rows by columns. For example, all rows belonging to song 1 will be selected if we select song 1 to be in Testing set.

Our Combinations

1.	Train - Test Split	Train Test Split Yuxiang's 36 Songs
2.	Train - Test Split	Combine both YuXiang's and Luqman's 6 song each
3.	Manual Split	Train on Yuxiang's 30 song, test on Yuxiang's 6 songs
4.	Manaul Split	Train on 36 YuXiang's Song, test on Luqman
5.	Manual Split	Combine both Yuxiang and luqman 5 songs each and test on each of our 1 song
6.	Manual Split	Train on YuXiang's 30 song, test on Luqman's 6 songs

Classification Algorithms

Individual Classifiers	Ensemble Techniques
Logistic Regression	Random Forest
Support Vector Machine	Adaboost (Base = Decision Tree)
K-Nearest Neighbours	Gradient Boosting
Decision Tree Classifier	Extreme Gradient Boosting
Gaussian Naives Bayes	Bagging Classifier
-	Extra Tree Classifier

Analysis of Results

			Top F1 Score		
Model	Training Condition	Aggregation Method	PM	Beta Waves	All POW Waves
1	Yu Xiang's 36 Song	Train Test Split (80% - 20%)	0.916	0.859	0.732
			ETC	ETC	ETC
2	Combine both Yu Xiang's and Luqman 6 songs each	Train Test Split (80% - 20%)	0.958	0.943	0.926
			ETC	ETC	ETC
3	Train on Yuxiang's 30 songs, and test on Yuxiang's 6 songs (Aggregated by songs)	Manual Train Test Split (80%-20%)	0.460	0.379	0.381
			Gaussian NB	Decision Tree	Decision Tree
4	Train on 36 Yuxiang's song and test on 6 Luqman's songs (Aggregated by songs)	Manual Train Test Split (80%-20%)	0.644	0.773	0.585
			Gaussian NB	Logistic Reg	Decision Tree
5	Combine both Yuxiang and Luqman's 5 songs each and test on each one of our song (Aggregated by songs)	Manual Train Test Split (80%-20%)	0.647	0.649	0.760
			Decision Tree	Random Forest	Gaussian NB
6.	Train on 30 YuXiang's Songs and test on Luqman's 6 Songs	Manual Train Test Split (80% - 20%)	0.643	0.771	0.782
			Gaussian NB	Logistic Reg	Gaussian NB

Analysis of Result

INSIGHT 1: COMPARISON OF MODEL 1 AND 3

1	Yu Xiang's 36 Song	Train Test Split (80% - 20%)	0.916	0.859	0.732
			ETC	ETC	ETC
3	Train on Yuxiang's 30 songs, and test on Yuxiang's 6 songs (Aggregated by songs)	Manual Train Test Split (80%-20%)	0.460	0.379	0.381
			Gaussian NB	Decision Tree	Decision Tree

Expected Results: Model 1 will perform better

The great decrease in F1 Score, suggest that it is possible that the waves values differ greatly from song to song.

Analysis of Result

INSIGHT 2: COMPARISON OF MODEL 2 & 5

2	Combine both Yu Xiang's and Luqman 6 songs each	Train Test Split (80% - 20%)	0.958	0.943	0.926
			ETC	ETC	ETC
5	Combine both Yuxiang and Luqman's 5 songs each and test on each one of our song (Aggregated by songs)	Manual Train Test Split (80%-20%)	0.647	0.649	0.760
			Decision Tree	Random Forest	Gaussian NB

Expected Results: Model 2 will perform better

However, decrease in F1 score (19.8%) , reinforces insights from Comparision 1.

Analysis of Result

INSIGHT 3: COMPARISON OF MODEL 3 & 6

3	Train on Yuxiang's 30 songs, and test on Yuxiang's 6 songs (Aggregated by songs)	Manual Train Test Split (80%-20%)	0.460	0.379	0.381
			Gaussian NB	Decision Tree	Decision Tree
6.	Train on 30 YuXiang's Songs and test on Luqman's 6 Songs	Manual Train Test Split (80% - 20%)	0.643	0.771	0.782
			Gaussian NB	Logistic Reg	Gaussian NB

Expected Results: Model 3 will perform better

Yuxiang 6 songs dataset has existing outliers / noise in the dataset, which resulted in a lower test F1 score.

Analysis of Result

INSIGHT 4: COMPARISON OF MODEL 4 & 6

4	Train on 36 Yuxiang's song and test on 6 Luqman's songs (Aggregated by songs)	Manual Train Test Split (80%-20%)	0.644	0.773	0.585
			Gaussian NB	Logistic Reg	Decision Tree
6.	Train on 30 YuXiang's Songs and test on Luqman's 6 Songs	Manual Train Test Split (80% - 20%)	0.643	0.771	0.782
			Gaussian NB	Logistic Reg	Gaussian NB

Expected Results: Model 4 will perform better

- **Overfitted on Yuxiang's data, unable to generalise well to luqman dataset**
- **Yuxiang's 6 song dataset have outlier/noise**
- **Model 4 and 6 does not differ much for PM and Beta Waves.**

Conclusion

INSIGHTS:

TOP PERFORMING (MANUAL TRAIN TEST)

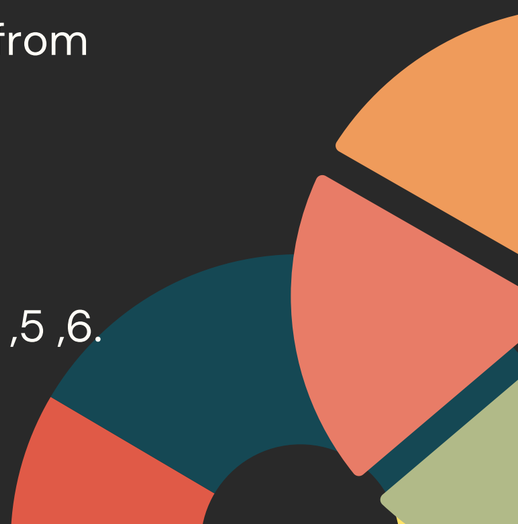
Classifiers: GaussianNB, KNN, DecisionTreeClassifier
Attribute set: All waves, Beta Waves

AGGREGATION HYPOTHESIS:

Models cannot predict accurately when it has not been trained on any rows of the test songs. This could be because stimulating and non-stimulating values may differ from songs to songs.

GENERALISABILITY:

Models can be generalisable from one person to another as shown by Model 2, 4 ,5 ,6.



Future Works

WHAT'S NEXT FOR THE PROJECT?

1. TRYING OUT ON MORE COMBINATIONS OF ATTRIBUTES

Trying on more combinations of attributes (e.g. other waves)

2. DETERMINING ONLY THE USEFUL FEATURES

Feature selection (from EDA, some sensors/attributes may not necessarily be useful in the predictions and may only add noise to the data)

3. HYPERTUNING FOR MODELS

Tracking of rows of data that belongs to the same song.

4. AGGREGATION HYPOTHESIS

Check on the values of stimulation, non-stimulation within different songs for the same person

Thank you for listening.