**Cognitive Dissonance- Analyzing emotion data**

**Dataset**- Emotion/Micro expression of 7 candidates. Below are the results from two of the candidates 2(highest accuracy) and 5 (least accuracy). The dataset is divided in three labels – Neutral, Dissonance, True.

**Data Visualization and Analysis**

We first analyze the data:

**Density Plots**: The graphs below show the frequency distribution of each emotion. The x axis is the value each emotion has been assigned and the y axis the frequency.

Candidate 2:

A close up of a map

Description automatically generated

Candidate 5:

A close up of a map

Description automatically generated

We can see that most emotions follow the similar distribution. But still each individual has some typical emotional signatures.

Next we see the average values of the emotions with respect to each label:

Candidate 2

A screenshot of a cell phone

Description automatically generated

Candidate 5:

A screenshot of a cell phone

Description automatically generated

It is interesting to note that each individual has different emotional response to dissonance.

**Correlation among different features**

Below we see the correlation among different emotions/microexpressions:

|  |  |
| --- | --- |
| A picture containing drawing  Description automatically generated | A close up of a logo  Description automatically generated |
| Candidate 2 | Candidate 5 |

We can see that they are not highly correlated and thus each can be used to determine the state.

**Model Metrics**

Next we trained the different classifiers the table below summarizes the results:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Metrics** | **Model\_LinearSVM** | **Model\_RBF\_SVM** | **Model\_DT** | **Model\_Logreg** | **Model\_RF** | | Accuracy\_Train | 0.66832386 | 0.70075758 | 0.99550189 | 0.68868371 | 0.99550189 | | Precision\_Train | 0.66832386 | 0.70075758 | 0.99550189 | 0.68868371 | 0.99550189 | | Recall\_Train | 0.66832386 | 0.70075758 | 0.99550189 | 0.68868371 | 0.99550189 | | Accuracy\_Test | 0.68963068 | 0.73224432 | 0.84090909 | 0.71448864 | **0.88778409** | | Precision\_Test | 0.68963068 | 0.73224432 | 0.84090909 | 0.71448864 | **0.88778409** | | Recall\_Test | 0.68963068 | 0.73224432 | 0.84090909 | 0.71448864 | **0.88778409** | | Candidate 2 |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Metrics** | **Model\_LinearSVM** | **Model\_RBF\_SVM** | **Model\_DT** | **Model\_Logreg** | **Model\_RF** | | Accuracy\_Train | 0.47116737 | 0.48646273 | 0.9616737 | 0.47609001 | 0.96158579 | | Precision\_Train | 0.47116737 | 0.48646273 | 0.9616737 | 0.47609001 | 0.96158579 | | Recall\_Train | 0.47116737 | 0.48646273 | 0.9616737 | 0.47609001 | 0.96158579 | | Accuracy\_Test | 0.46703586 | 0.48602321 | 0.56619198 | 0.4757384 | **0.66640295** | | Precision\_Test | 0.46703586 | 0.48602321 | 0.56619198 | 0.4757384 | **0.66640295** | | Recall\_Test | 0.46703586 | 0.48602321 | 0.56619198 | 0.4757384 | **0.66640295** | | Candidate 5 |

Out of the 5 classifiers considered (viz: Linear SVM, RBF SVM, Decision Trees (DT), Logistic Regression and Random Forest Classifier (RF)) the Random Forest gave best results for all the candidates.

The confusion metrics obtained using RF for the two candidates:

|  |  |
| --- | --- |
| A screenshot of a cell phone  Description automatically generated | A screenshot of a cell phone  Description automatically generated |
| Candidate 2 | Candidate 5 |

**Feature Importance**

And lastly the features importance as obtained through decision tree and random forest (using Gini Importance).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | | **Features** | **Model\_DT** | **Model\_RF** | | Neutrality | 0.18924936 | 0.2099599 | | **Happy** | 0.23048764 | **0.21122744** | | Surprise | 0.13770683 | 0.12984301 | | **Fear** | 0.04288796 | **0.04589976** | | Disgust | 0.1190865 | 0.11667678 | | Anger | 0.08843253 | 0.10224958 | | Sadness | 0.19214918 | 0.18414353 | | |  |  |  | | --- | --- | --- | | **Features** | **Model\_DT** | **Model\_RF** | | Neutrality | 0.18924936 | 0.2099599 | | **Happy** | 0.23048764 | **0.21122744** | | Surprise | 0.13770683 | 0.12984301 | | **Fear** | 0.04288796 | **0.04589976** | | Disgust | 0.1190865 | 0.11667678 | | Anger | 0.08843253 | 0.10224958 | | Sadness | 0.19214918 | 0.18414353 | |
| **Candidate 2** | **Candidate 5** |

For these two candidates the feature importance is same.

**Conclusion**: We can use micro-expressions to detect the dissonance state.