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18CSC491

FACIAL EMOTION RECOGNITION

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WHY EMOTION DETECTION?

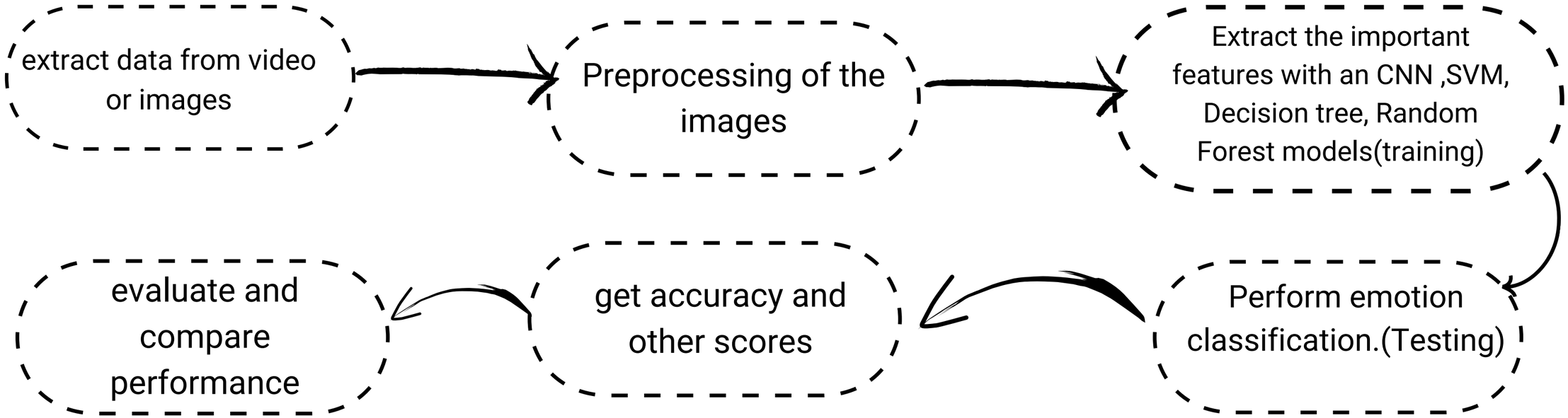
- The motivation behind choosing this topic specifically lies in the huge investments large corporations do in feedbacks and surveys but fail to get equitable response on their investments
- Emotion detection through facial gestures is a technology that aims to improve product and services performance by monitoring customer behavior to certain products and services performance by monitoring customers behavior to certain products or service staff by their evaluation.

INTRODUCTION TO THE WORK

- OBJECTIVE: The goal of this project is to build a system that can automatically recognize and classify human emotions based on facial expressions. We leverage a dataset of facial images labeled with corresponding emotions to train and evaluate our models. The dataset consists of images representing different facial expressions such as happiness, sadness, anger, surprise, and more.
- Among all high level visual tasks, visual emotion analysis is one of the most challenging tasks for the existing affective gap between low-level pixels and high-level emotions. With the rapid development of convolution neural network(cnn),deep learning became the new level of choice for emotion analysis tasks.

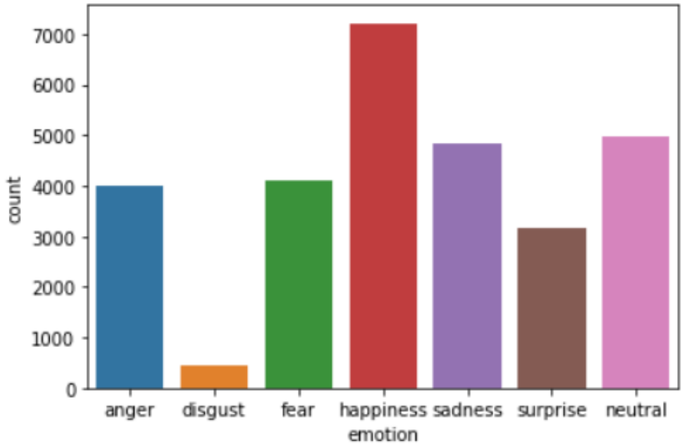
EMOTION#1:Angry
EMOTION#2:Disgust
EMOTION#3:Fear
EMOTION#4:Happy
EMOTION#5:Sad
EMOTION#6:Surprise
EMOTION#7:Neutral

WORK PLAN/MILESTONES:



Testing dataset

	pixels
0	254 254 254 254 254 249 255 160 2 58 53 70 77 ...
1	156 184 198 202 204 207 210 212 213 214 215 21...
2	69 118 61 60 96 121 103 87 103 88 70 90 115 12...
3	205 203 236 157 83 158 120 116 94 86 155 180 2...
4	87 79 74 66 74 96 77 80 80 84 83 89 102 91 84 ...



Training dataset

	emotion	pixels
0	0	70 80 82 72 58 58 60 63 54 58 60 48 89 115 121...
1	0	151 150 147 155 148 133 111 140 170 174 182 15...
2	2	231 212 156 164 174 138 161 173 182 200 106 38...
3	4	24 32 36 30 32 23 19 20 30 41 21 22 32 34 21 1...
4	6	4 0 0 0 0 0 0 0 0 0 0 0 3 15 23 28 48 50 58 84...

CONVOLUTION NEURAL NETWORK(CNN):

```
X.max()
```

```
255.0
```

min-max normalization

```
X.max()
```

```
1.0
```

```
X.min()
```

```
0.0
```

```
X.min()
```

```
0.0
```

```
print(df.shape)
```

```
(28709, 2)
```

```
X.shape
```

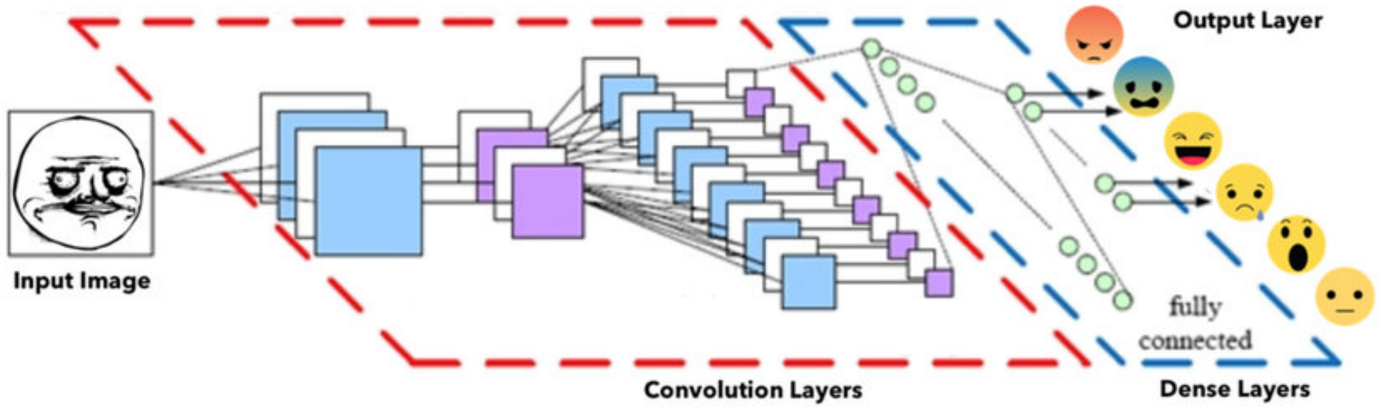
```
(28709, 48, 48, 1)
```

```
y.shape
```

```
(28709,)
```

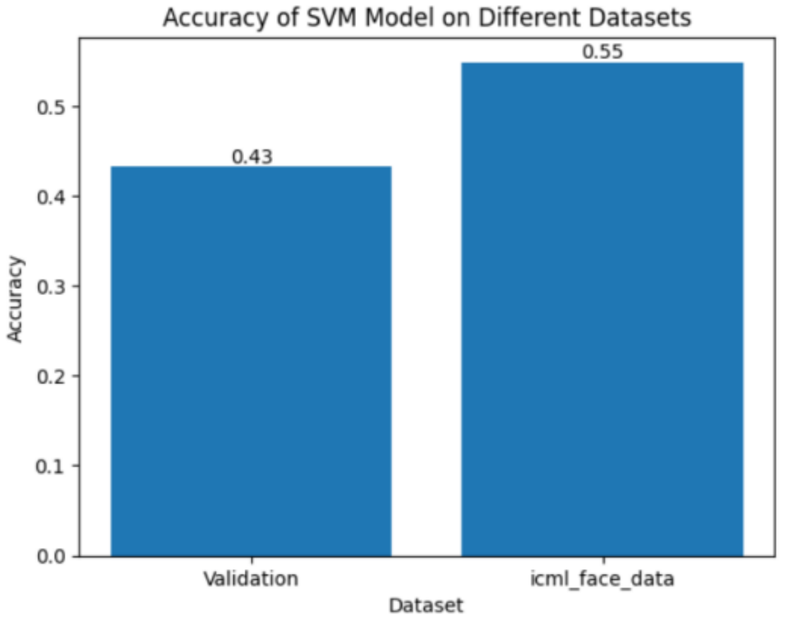
Conv2D: 8 layers
BatchNormalization: 8 layers
MaxPooling2D: 4 layers
Dropout: 5 layers
Flatten: 1 layer
Dense: 2 layers

```
Accuracy 0.7556934952735901
```



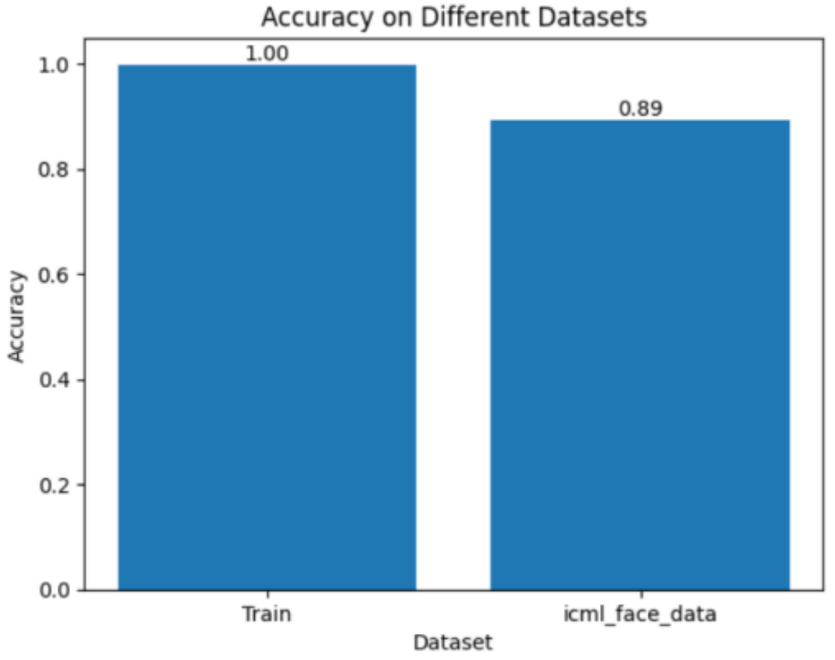
SUPPORT VECTOR MACHINE:

- The Support Vector Machine (SVM) algorithm works by finding an optimal decision boundary that separates different emotions based on the provided input features, which are typically pixel values of facial images in this case.
- During the training process, the SVM algorithm identifies a decision boundary (hyperplane) that best separates different emotion classes. The hyperplane is selected in a way that maximizes the margin between the support vectors, which are the data points closest to the decision boundary.
- Dimensionality reduction is applied using Principal Component Analysis (PCA) with a target explained variance of 0.95.



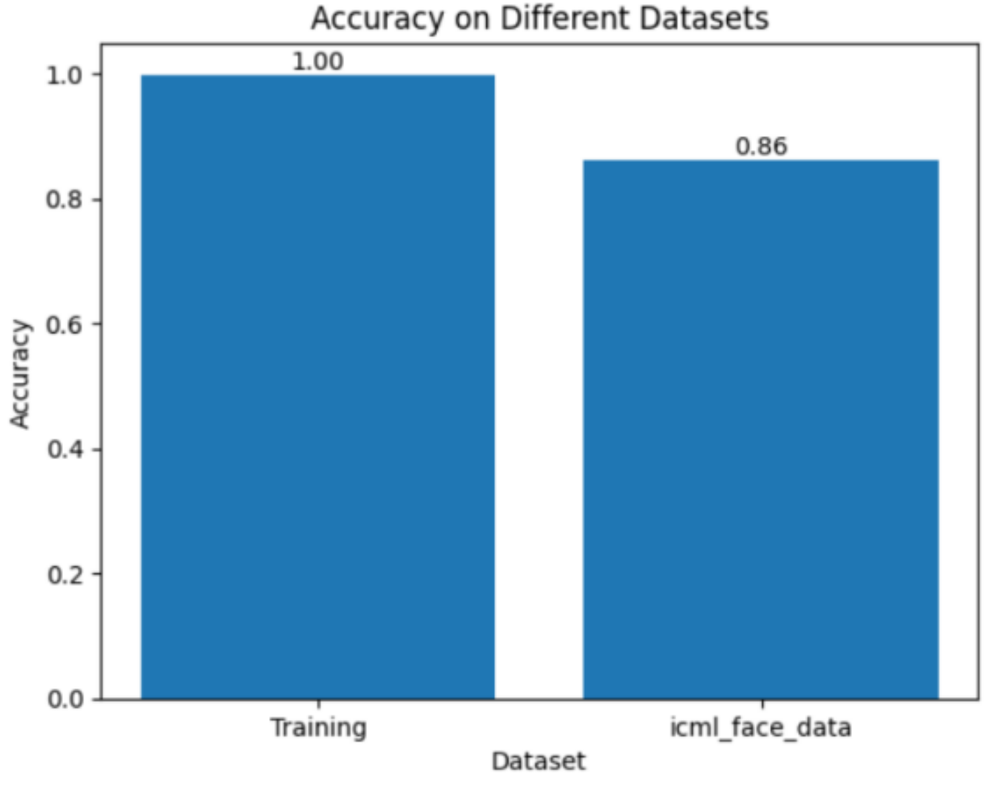
RANDOM FOREST CLASSIFIER:

- The Random Forest algorithm builds a collection of decision trees based on bootstrapped samples of the training data. Each decision tree is trained on a random subset of features and a random subset of the training data. This randomness helps to reduce overfitting and improves the model's generalization ability.
- Each decision tree in the Random Forest is constructed by recursively partitioning the feature space. At each node of the tree, a split is made based on a selected feature and a threshold value. The goal is to maximize the separation of different emotion classes and minimize impurity within each split.
- The randomness in both feature selection and data sampling helps to reduce overfitting and improve generalization.



DECISION TREE CLASSIFIER:

- The Decision Tree algorithm builds a tree-like structure recursively by partitioning the feature space. The goal is to create decision rules that separate different emotion classes effectively.
- The Decision Tree algorithm starts with the entire dataset and selects a feature and a threshold value that optimally splits the data into two subsets. This split is determined based on criteria such as Gini impurity or information gain, which measure the purity of the subsets in terms of emotion classes. The process is repeated recursively for each subset until a stopping criterion is met, such as reaching a maximum depth or minimum number of samples in a leaf node.



COMPARISION AND OVERALL PERFORMANCE :

- CNN Model:
  Accuracy: 0.7556934952735901
- SVM Model:
  Accuracy on icml_face_data: 0.55
  Accuracy in validation: 0.43
- Decision Tree Model:
  Accuracy on training dataset: 0.9985022118499425
  Accuracy on icml_face_data: 0.8616490651210745
- Random Forest Model:
  Train Accuracy: 0.9985022118499425
  icml_face_data Accuracy: 0.8926073508512832
- The CNN model has the highest accuracy among the models provided. It achieved an accuracy of 0.7556934952735901 on the icml_face_data dataset.
- The Decision Tree and Random Forest models have high accuracy on the training dataset (both around 0.9985), indicating potential overfitting as the models might have memorized the training data.
- The SVM model has relatively lower accuracy on both the icml_face_data dataset (0.55) and the validation dataset (0.43).
- The Random Forest model performs better than the Decision Tree model on the icml_face_data dataset, achieving an accuracy of 0.8926073508512832.
- In conclusion, the CNN model showed the best performance among the models considered in this project, with the highest accuracy on the icml_face_data dataset.

REFERENCES

- facial-emotion-recognition-gluon
  -- TalkAI
  --Sandeep Krishnamurthy
  -- https://github.com/TalkAI/facial-emotion-recognition-gluon
- visual-emotion-ai-recognition
  -- viso.ai
  --Gaudenz Boesch
  -- https://viso.ai/deep-learning/visual-emotion-ai-recognition/
- facial-emotion-recognition-using-cnn
  -- Facial Expression Recognition Challenge.
  -- poojita2305
  -- https://www.kaggle.com/code/poojita2305/facial-emotion-recognition-using-cnn/notebook
- Facial Expression Recognition Using Random Forest Classifier
  -- International Conference on Artificial Intelligence: Advances and Applications 2019.
  --Kamlesh Tiwari & Mayank Patel
  --DOI: 10.1007/978-981-15-1059-5_15

- face-detection-recognition-and-emotion-detection-in-8-lines-of-code-b2ce32d4d5de o ---------- -- towardsdatascience.com
  -- Priya Dwivedi
  -- https://towardsdatascience.com/face-detection-recognition-and-emotion-detection-in-8-lines-of-code-b2ce32d4d5de
- Facial Expression Recognition Based on SVM in E-learning
  --IERI Procedia
  --Liyuan Chen , Changjun Zhou , Liping Shen .
  -- https://doi.org/10.1016/j.ieri.2012.06.171
- Emotion Detection from Facial Expression using Support Vector Machine.
  -- volume167
  -- Vanita Jain ,Pratiksha Aggarwal ,Tarun Kumar, Vaibhav Taneja.
  -- https://www.ijcaonline.org/archives/volume167/number8/jain-2017-ijca-914398.pdf
- Facial Expression Recognition Using Facial Landmarks and Random Forest Classifier
  --ieeexplore.ieee.org
  --M. I. N. P. Munasinghe
  -- **DOI:** 10.1109/ICIS.2018.8466510