



COMP 6721 Applied Artificial Intelligence

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NS 01

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Chapter 1

Dataset

1.1 Facial Expression Recognition(FER) 2013 Dataset

The main Dataset for the project is FER2013 [1]. Dataset was prepared by Pierre-Luc Carrier and Aaron Courville, as part of an ongoing research project. This dataset consists of 48×48 pixel grayscale images of faces and totally the Dataset consists of **32298** examples. The faces have been automatically registered so that the face is more or less centered and occupies about the same amount of space in each image. There Seven emotions which is expressed in face pictures

1. Angry
2. Disgust
3. Fear
4. Happy
5. Sad
6. Surprise
7. Neutral

1.2 FER+

In 2016 Emad Barsoum et al. in their paper "Training Deep Networks for Facial Expression Recognition with Crowd-Sourced Label Distribution" [2] used Crowd-sourcing and 10 taggers to label each input image of FER2013, and compared four different approaches to utilizing the multiple labels.

The dataset contained the original number of samples, the difference was that emotions mentioned in the previous section in addition to "Not Face" and "Unknown" Labels were voted by 10 taggers and the score of each label had been recorded.

Table 1.1: Sample of FER2013 Dataset

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

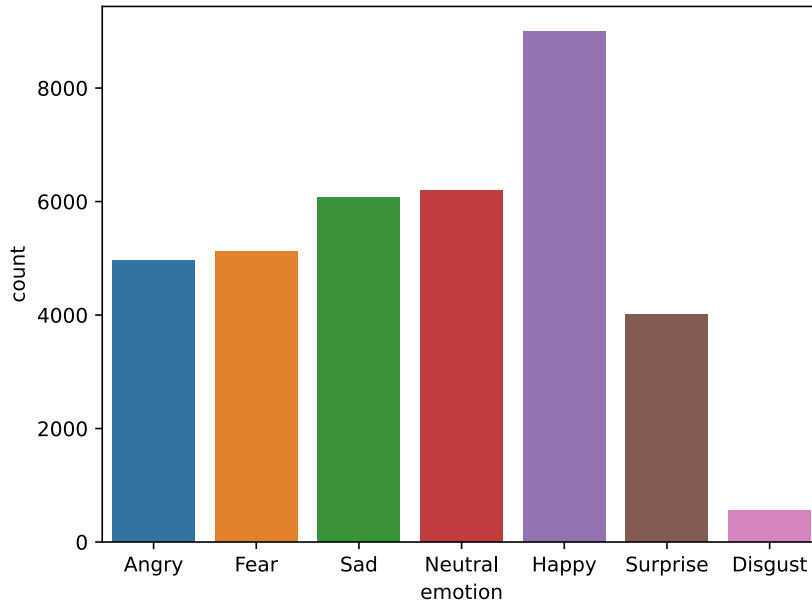


Figure 1.1: Number of images per each emotion in FER2013

Table 1.2: Sample of FER+ merged with FER2013

emotion	pixels	neutral	happiness	surprise	sadness	anger	disgust	fear	contempt	unknown	NF
Angry	70 80 ...	4	0	0	1	3	2	0	0	0	0
Angry	151 150 ...	6	0	1	1	0	0	0	0	2	0
Fear	231 212 8 ...	5	0	0	3	1	0	0	0	1	0
Sad	24 32 ...	4	0	0	4	1	0	0	0	1	0

We merged two datasets to create more accurate dataset which it the intensity of each emotions can be measured by the number of votes each label had received by the taggers. For the project, Neutral and Angry labels can be used directly. Based on the scores for each emotion in FER+ and the ratio two other labels of 'Bored/Tired' and 'Engaged/Focused' can be extracted which the methodology will be described in the coming sections.

Chapter 2

Data Cleaning

2.1 Removing images labels as 'Not Face'

Firstly, there are many images which were labeled as 'Not Face' there are 4 different scores which some images had received from taggers:

- number of images with score $NF = 10$ is 176.
- number of images with score $NF = 4$ is 2.
- number of images with score $NF = 2$ is 4.
- number of images with score $NF = 1$ is 167.

a sample of images which was labeled by taggers as 'Not Face' can be seen in fig.???. As the total numbers of images with NF score of non-zero in comparison to the total dataset size is relatively small we removed all the images with NF score of non-zero.



Figure 2.1: Images with "Not Face" score of non-zero

2.2 Removing images labels as 'Unknown'

The same must be done with the images labeled as unknown. The "unknown" score for images is as follows:

- number of images with score unknown=8 is 3.
- number of images with score unknown=7 is 3.
- number of images with score unknown=6 is 18.
- number of images with score unknown=5 is 55.
- number of images with score unknown=4 is 224.
- number of images with score unknown=3 is 751.
- number of images with score unknown=2 is 2526.
- number of images with score unknown=1 is 8220.



(a) Images with unknown=6



(b) Images with unknown=5

Figure 2.2: Images with "unknown" score of non-zero

Based on Fig.2.2 we decided to remove any image with 'unknown' score of 5 and more.

Chapter 3

Labeling

For the project we must be able to classify four labels, Anger, Neutral, Bored and Focused. The original dataset has the emotions of Anger and Neutral, however, there is no emotions specifically depicting Being bored or focused. In this chapter the methodology for extracting the target labels from the original scores will be explained.

3.1 Anger

The criteria to label an image 'Angry' based on the emotions score was fairly easy. if the angry score had the highest value among other emotions we labeled the image 'Angry'. if some rare cases it might be possible that all the scores were the same. so we added another criteria which indicated that the angry score must be at least more than 2 as well.

3.2 Neutral

If the neutral score had the maximum value among other emotions the image was labeled as neutral.

3.3 Focused

By analyzing the pictures which imaged a focused face we found that this face expression has no sign of sadness and the neutral score should be more than other emotion scores.

3.4 Bored

This face expression criteria was driven by that when you are bored are not happy, also there is no fear when someone is bored. the bored person might be angry but the anger should be less than the sadness the face is expressing.

Table 3.1: Summary of criterion's for labeling images based on emotion's scores

Label	criteria
Anger	<ul style="list-style-type: none"> • Anger score $>$ other emotion's score • Anger score > 2
Neutral	<ul style="list-style-type: none"> • Neutral score $>$ other emotion's score
Focused	<ul style="list-style-type: none"> • sadness score $== 0$ • neutral score $>$ other emotion's score
Bored	<ul style="list-style-type: none"> • happiness score $== 0$ • fear score $== 0$ • anger score $<$ sadness score

Chapter 4

Dataset Visualization

Finally, after removing and cleaning the data followed by extracting the desired label the dataset contains:

- number of samples for neutral: 6184
- number of samples for angry: 3954
- number of samples for focused: 5453
- number of samples for bored: 3168

The bar-plot of the plot's per emotion is shown in Fig. ??

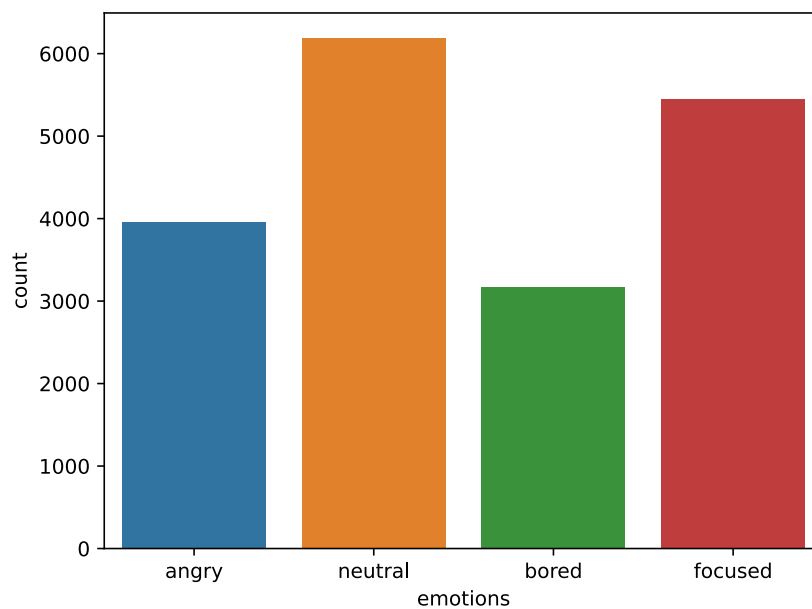
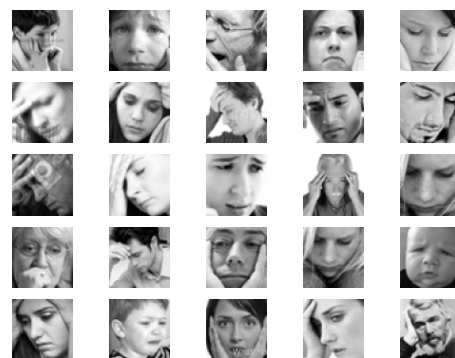


Figure 4.1: Bar-plot of images per desired emotion



(a) Samples of images labeled as 'Angry'



(b) Samples of images labeled as 'Bored'



(c) Samples of images labeled as 'Neutral'



(d) Samples of images labeled as 'Focused'

Figure 4.2: Samples of the cleaned dataset

Bibliography

- [1] W. C. Y. B. Dumitru, Ian Goodfellow, “Challenges in representation learning: Facial expression recognition challenge,” 2013.
- [2] E. Barsoum, C. Zhang, C. C. Ferrer, and Z. Zhang, “Training deep networks for facial expression recognition with crowd-sourced label distribution,” in *Proceedings of the 18th ACM international conference on multimodal interaction*, pp. 279–283, 2016.