COMP 472 Project Part 1

Summer 2024

Due Date: May 31, 2024

Submitted by Group AK-2

We certify that this submission is the original work of members of the group and meets the Faculty's Expectations of Originality

Name	ID	Role	Signature	Date
Nadia Beauregard	40128655	Training Specialist & Developer		**30/05/2024**
Marina Girgis	40168639	Evaluation Specialist & Developer		**29/05/2024**
Karina Sanchez-Duran	40189860	Data Specialist & Developer		**30/05/2024**

Link to Github Repo:

https://github.com/KarinaSandur/COMP472_SmartClass_A.I.ssistant

Originality Forms

Faculty of Engineering and Computer Science
Expectations of Originality

This form sets out the requirements for originality for work submitted by students in the Faculty of Engineering and Computer Science. Submissions such as assignments, lab reports, project reports, computer programs and take-home exams must conform to the requirements stated on this form and to the Academic Code of Conduct. The course outline may stipulate additional requirements for the course.

1. Your submissions must be your own original work. Group submissions must be the original work of the students in the group.
2. Direct quotations must not exceed 5% of the content of a report, must be enclosed in quotation marks, and must be attributed to the source by a numerical reference citation[1]. Note that engineering reports rarely contain direct quotations.
3. Material paraphrased or taken from a source must be attributed to the source by a numerical reference citation.
4. Text that is inserted from a web site must be enclosed in quotation marks and attributed to the web site by numerical reference citation.
5. Drawings, diagrams, photos, maps or other visual material taken from a source must be attributed to that source by a numerical reference citation.
6. No part of any assignment, lab report or project report submitted for this course can be submitted for any other course.
7. In preparing your submissions, the work of other past or present students cannot be consulted, used, copied, paraphrased or relied upon in any manner whatsoever.
8. Your submissions must consist entirely of your own or your group's ideas, observations, calculations, information and conclusions, except for statements attributed to sources by numerical citation.
9. Your submissions cannot be edited or revised by any other student.
10. For lab reports, the data must be obtained from your own or your lab group's experimental work.
11. For software, the code must be composed by you or by the group submitting the work, except for code that is attributed to its sources by numerical reference.

You must write one of the following statements on each piece of work that you submit:
For individual work: **"I certify that this submission is my original work and meets the Faculty's Expectations of Originality",** with your signature, I.D. #, and the date.
For group work: **"We certify that this submission is the original work of members of the group and meets the Faculty's Expectations of Originality",** with the signatures and I.D. #s of all the team members and the date.

A signed copy of this form must be submitted to the instructor at the beginning of the semester in each course.

I certify that I have read the requirements set out on this form, and that I am aware of these requirements. I certify that all the work I will submit for this course will comply with these requirements and with additional requirements stated in the course outline.

Course Number:	Comp 472	Instructor:	Dr. René Witte
Name:	Nadia Beauregard	I.D. #	40128655
Signature:	Nadia Beauregard	Date:	30/05/2024

[1] Rules for reference citation can be found in "Form and Style" by Patrich MacDonagh and Jack Bordan, fourth edition, May, 2000, available at http://www.encs.concordia.ca/scs/Forms/Form&Style.pdf.
Approved by the ENCS Faculty Council February 10, 2012

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Course Number:	COMP 472	Instructor:	Dr. René Witte
Name:	Karina Sanchez-Duran	I.D. #	40189860
Signature:	Karina SD	Date:	May 30, 2024

[1] Rules for reference citation can be found in "Form and Style" by Patrich MacDonagh and Jack Bordan, fourth edition, May, 2000, available at http://www.encs.concordia.ca/scs/Forms/Form&Style.pdf.
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Course Number:	Comp 472	Instructor:	Dr. René Witte
Name:	Marina Girgis	I.D. #	40168639
Signature:		Date:	2024-05-30

Dataset

Dataset Overview

Overview of the Angry dataset:
The total number of images is 670, there are 2 classes: the training images with 442 images and the testing images with 228 images. The images chosen are mostly frontal face shots, but there are some side face images also.

Overview of the focused dataset:
The total number of images is 504, there are 2 classes: the training images with 403 images and the testing images with 101 images. The images chosen are mostly frontal face shots, but there are some side face images also with different backgrounds. Some of the images have a little part of another person's face. For the sake of variety, we chose people from different gender and age groups.

Overview of the happy dataset:
The total number of images is 516, there are 2 classes: the training images with 405 images and the testing images with 111 images. The images chosen are mostly frontal face shots, some people have more happier reactions than others, with different happy images, we cover a lot of smiles types.

Overview of the neutral dataset:
The total number of images is 559, there are 2 classes: the training images with 421 images and the testing images with 138 images. There are different backgrounds, whether it is in nature or coloured, we made sure that the images chosen have the full face pointed to the camera to have a full coverage of the neutral expressions.

Data Collection

1) **Facial Expressions Training:**

Source: Kaggle [1]

Description: An extensive collection of facial images labeled with different affective states (emotions) is called AffectNet. It has been specially processed for neural network applications, with an emphasis on real-world limitations like data quality and memory consumption. Every image has been scaled to 96 × 96 pixels, which is the fixed resolution. This guarantees consistency in the dimensions of the images, which is necessary for neural network inference and training.

Relevance: For the purpose of training and assessing machine learning models, particularly deep learning models like convolutional neural networks (CNNs), AffectNet offers an abundance of resources. It can be used by researchers to test out novel algorithms and methods in emotional computing and computer vision.

Difficulties: Although 96x96 pixels is a workable fixed resolution for memory constraints, it may be insufficient for some applications that need finer details. This may hinder models' ability to identify nuanced facial expressions.

2) **Selected Pictures from the Web for "focused" images:**

Source: A Variety of Websites [2]-[4]

Description: We carefully picked and downloaded pictures from several educational websites, online learning platforms, and stock photo sources to portray attentive and engaged students. These pictures show pupils engaged in learning activities and paying close attention, demonstrating their level of involvement.

Relevance: The model must be trained using these images in order to identify the engaged/focused class, which is necessary for our project. Usually, standard facial expression datasets do not have a good representation of this class.

Difficulties: There are a number of difficulties associated with manually sourcing these photos, such as guaranteeing demographic variety and preserving consistency in image quality. Furthermore, each photograph must be labeled and verified to guarantee that it truly depicts a focused and engaged condition.

Dataset	Link	License	Rating
Facial Expressions Training Data [1]	https://www.kaggle.com/datasets/noamsegal/affectnet-training-data?select=anger	Attribution-NonCommercial-ShareAlike	10/10 for usability
Pexels focused images [2]	https://www.pexels.com/search/focused/	Free to use	N/A
Freepik [3]	https://www.freepik.com/search?ai=excluded&format=search&last_filter=query&last_value=&query=&type=photo	Free to use	N/A
Unsplash [4]	https://unsplash.com/	Free to use	N/A

Table 1: Data Collection Information

Data Cleaning

One technique used to clean the data was to convert all the images in the entire dataset to the same format. The team chose to convert all images to JPEG to maximize space and because most of the images taken from existing datasets were already in JPEG format. To complete this conversion, a Python script called PNGtoJPEGConverter.py was created. The script takes a folder path as input and then converts all PNG files in the folder to JPEG [5].

Another technique used to standardize the dataset was to resize the images so they all have the exact same dimensions. To resize all the images in the dataset, a Python script called resizeImages.py was created that takes a folder path as input and then resizes all JPEG images in the folder to 150 x 150 [6]. Most images taken from the Kaggle dataset were 96 x 96 and most images taken from other sources were around 500 x 500. The decision to resize all the images to 150 x 150 was made to enlarge the 96 x 96 images to a more reasonable size without allowing them to become too pixelated. It was also thought that shrinking the images from around 500 x 500 to 150 x 150 wouldn't affect image quality that much.

To standardize the data, all images in a folder were renamed to a consistent format. To rename all the images in a folder, a Python script called renameImages.py was created [7]. The Python script takes a folder path and name as input and renames all the images with the inputted name as the prefix and a number as the suffix in increasing order (e.g. angry1, angry2, etc..).

Another method we used to clean the dataset was to manually inspect every image in each class. Every team member manually looked over roughly 1700 pictures in the dataset and cropped out images to have a better view of the person's face and/or to remove distracting things in the background that could confuse the AI.

The main difficulty we encountered was that the datasets from Kaggle were too big (approximately 3000-5000 images per class). Thus, the datasets were too big for us to manually inspect every image as planned (to crop them and ensure the facial expression matched the label) in the time given and the files were too big to upload to GitHub. Thus, the team decided to use only a subset of the data found on Kaggle, convert all the images to JPEG (as mentioned above) and place all the files in zip folders to save time and space.

See examples of data cleaning below:

‘Neutral’ Image Before Cleaning	‘Neutral’ Image After Cleaning
 ffhq_21 Share **Details** Type: PNG File Size: 20.6 KB File location: C:\Users\karin\Documents\AI... Date modified: 2024-05-27 2:57 PM Dimensions: 96 x 96	 n51 Share **Details** Type: JPG File Size: 4.77 KB File location: C:\Users\karin\Documents\AI... Date modified: 2024-05-28 7:00 PM Dimensions: 150 x 150

‘Focused’ Image Before Cleaning	‘Focused’ Image After Cleaning
 StockCake-Focused Conversation Moment_1716858004 Share **Details** Type: JPG File Size: 174 KB File location: C:\Users\karin\Documents\AI... Date modified: 2024-05-30 9:16 PM Dimensions: 816 x 1456	 focused_test74 Share **Details** Type: JPG File Size: 4.49 KB File location: C:\Users\karin\Documents\AI... Date modified: 2024-05-30 10:15 PM Dimensions: 150 x 150

Labeling

The images for the neutral class, the angry class and the happy class were mostly taken from the Kaggle dataset mentioned above and were already placed in folders labeled neutral, angry and happy, respectively.

There was no existing dataset for a ‘focused facial expression’ or at least none the team could find. Thus, team members each found approximately 170 images of people with a focused facial expression from a variety of sources. The focused images found amongst the team were combined and placed in a zip folder labeled focused.

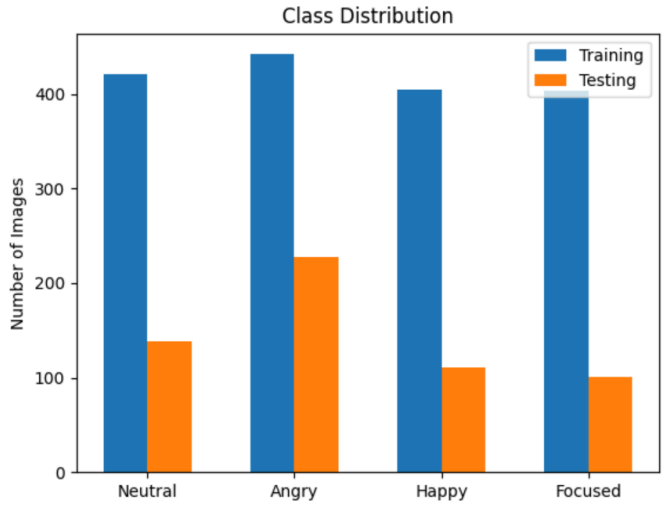
The images for ‘focused’ were handpicked from a variety of sources by each teammate. Thus, the team was certain that the images in the ‘focused’ folder were properly labeled (i.e: placed in the correct folder). However, the images for neutral, angry and happy were taken from Kaggle and the team decided it was necessary to verify each image was labeled correctly (placed in the right folder).

Given the time limitation, the team decided to only take a subset of the data found on Kaggle and thus took approximately 1000 images for neutral, 1000 images for angry and 1000 images for happy. Each team member inspected the images in one of the classes in order to ensure the images were properly labeled. In essence, team members checked that the images in the ‘angry’ folder were in fact all angry, all the images in the ‘happy’ folder were all happy and all the images in the ‘neutral’ folder were all neutral. Otherwise, the image was simply removed from the folder. In the end, each class contained around 500 - 600 images. Afterwards, the images in each class were subdivided into two: training images and testing images. The distribution for the classes can be seen in the *Class Distribution* graph below.

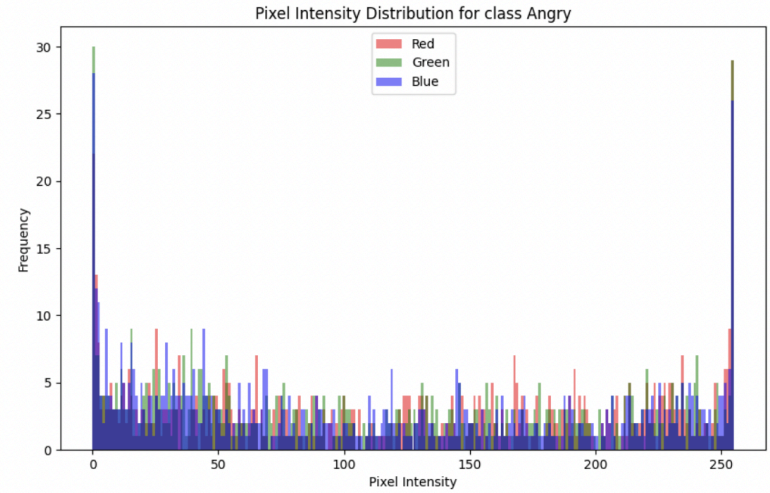
Dataset Visualization

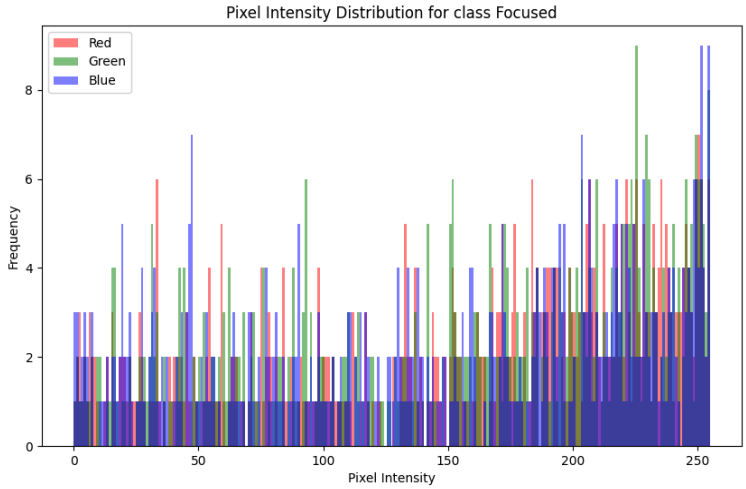
The following graphs were created using Matplotlib [8].

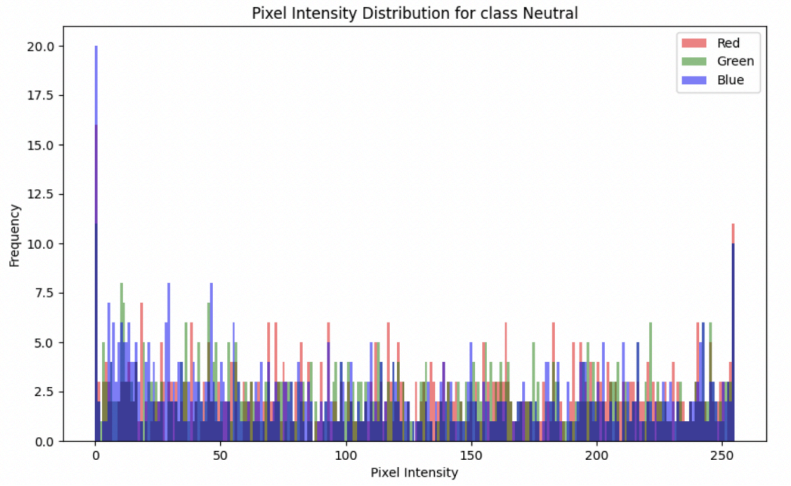
1) Class Distribution:

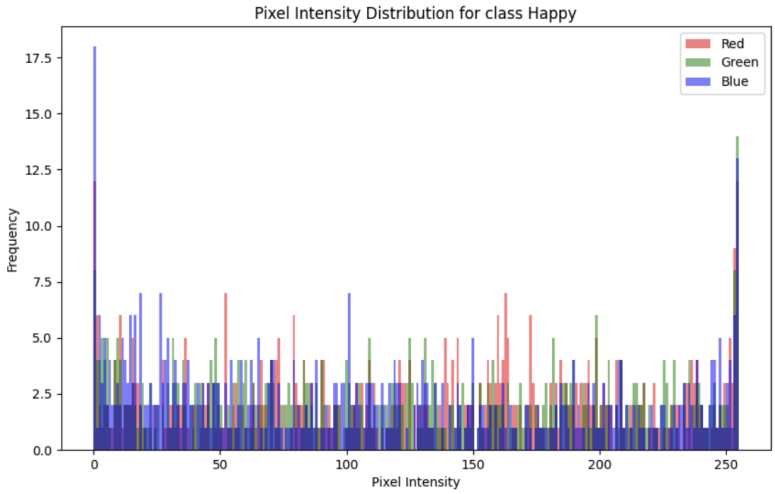


2) Pixel Intensity Distribution:



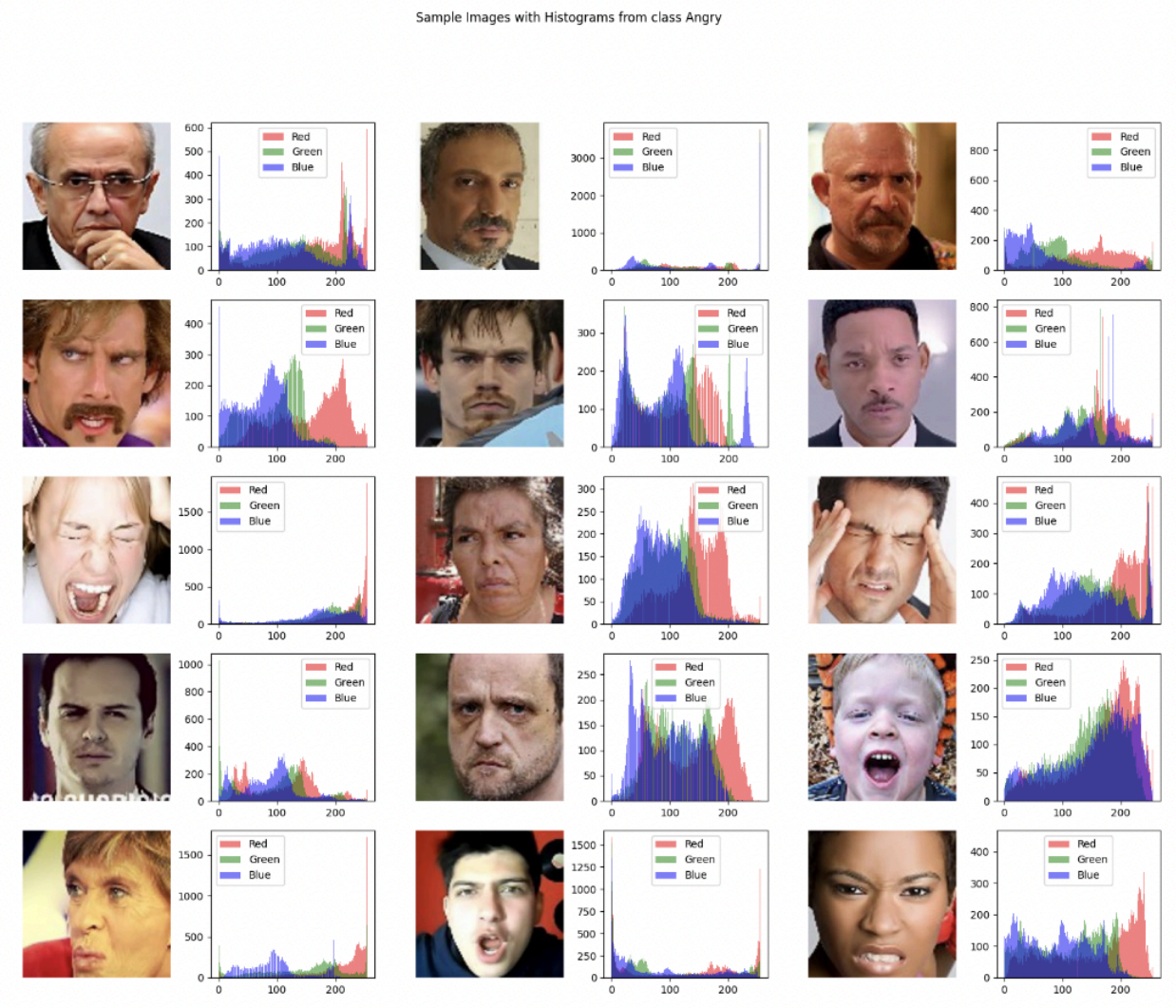

Pixel Intensity Distribution for class Focused
Red
Green
Blue
Frequency
Pixel Intensity
0
2
4
6
8
0
50
100
150
200
250


Pixel Intensity Distribution for class Neutral
Red
Green
Blue
Frequency
Pixel Intensity
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
0
50
100
150
200
250

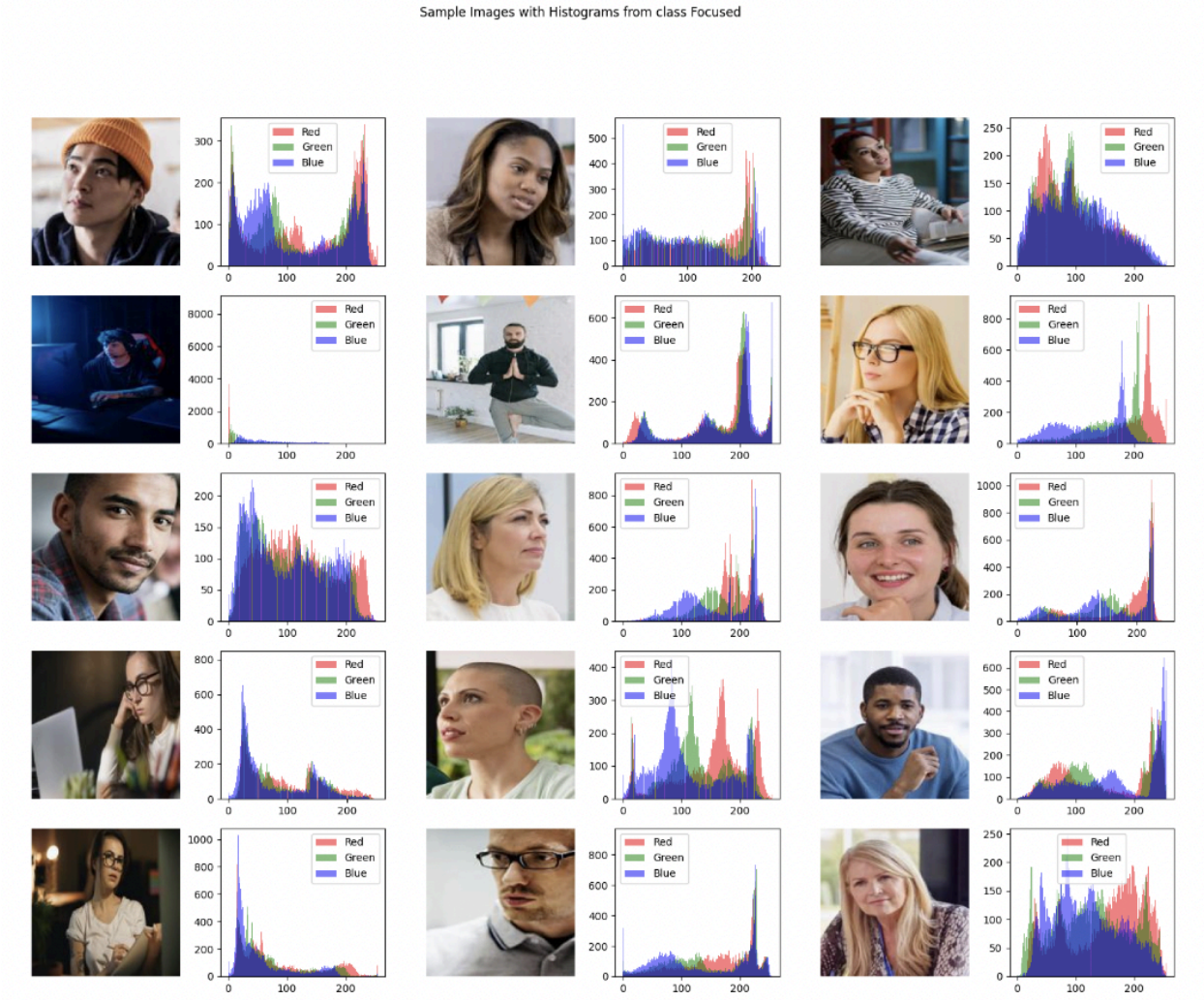

Pixel Intensity Distribution for class Happy
Red
Green
Blue
Frequency
Pixel Intensity
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
0
50
100
150
200
250

3) Sample Images:

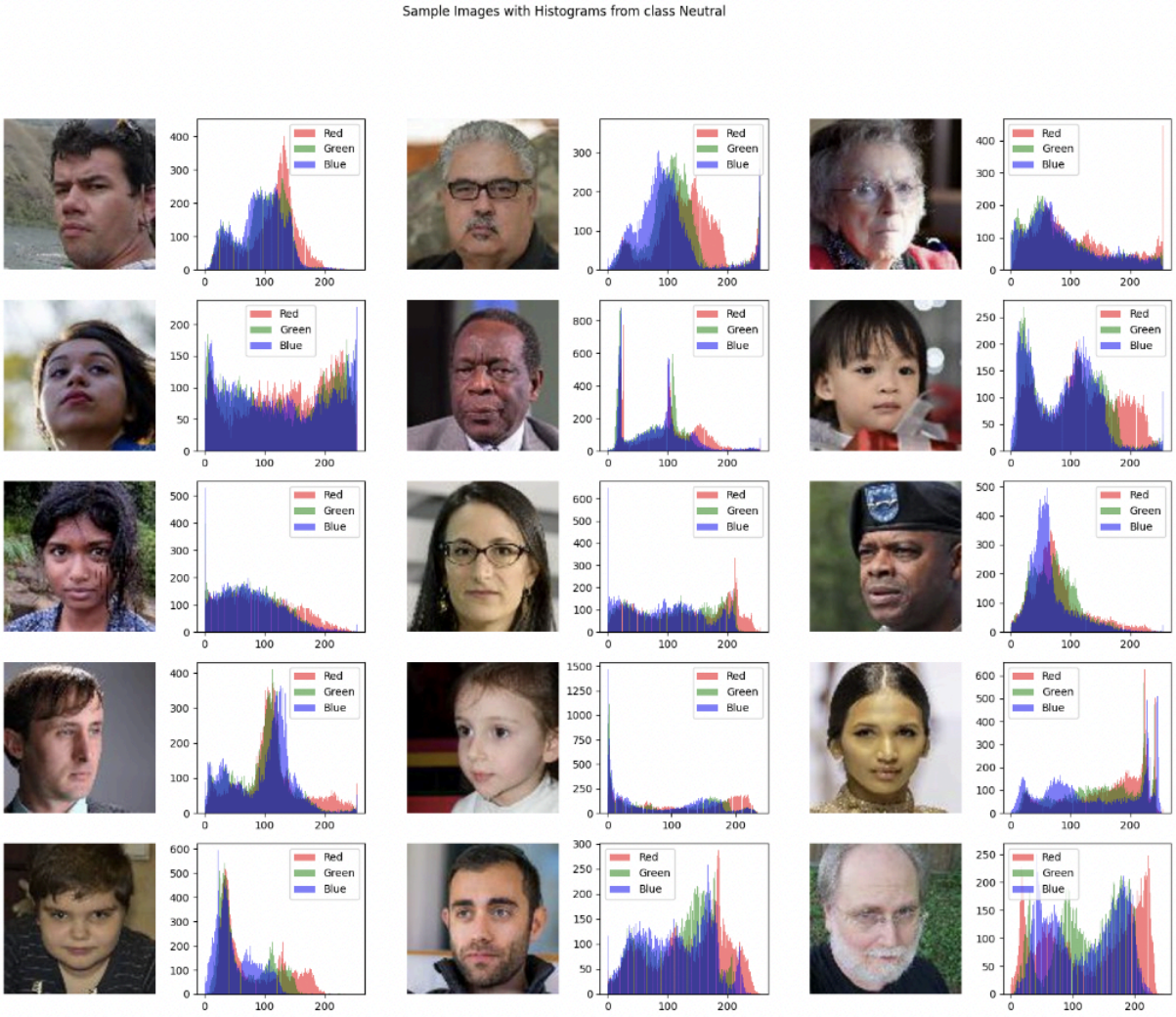
Class Angry:



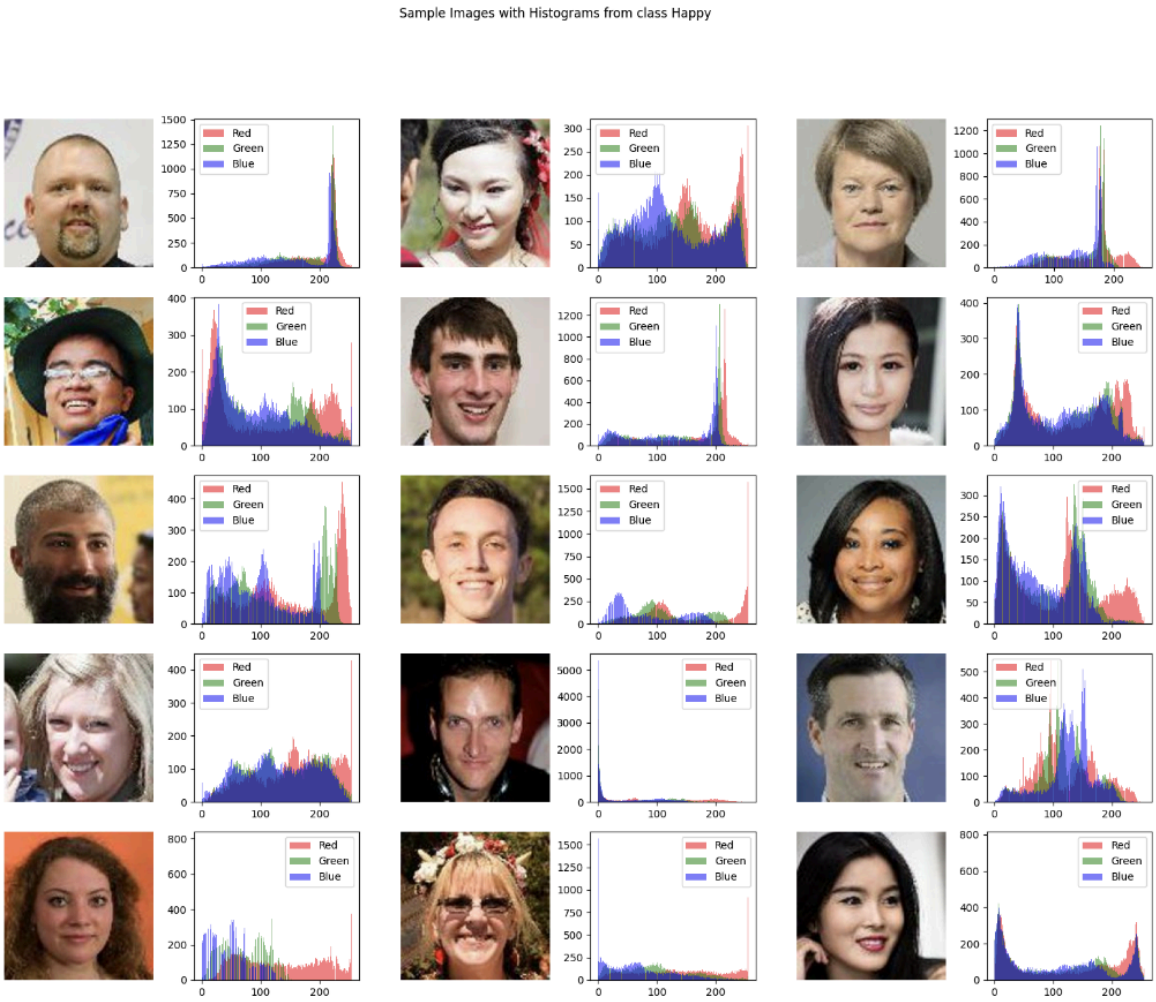
Class Focused:



Class Neutral:



Class Happy:


Sample Images with Histograms from class Happy
Red
Green
Blue

References

[1] N. Segal, “Facial expressions training data,” Kaggle, https://www.kaggle.com/datasets/noamsegal/affectnet-training-data?select=anger (accessed May 24, 2024).

[2] Focused Photos, Download Free Focused Stock Photos & HD Images, https://www.pexels.com/search/focused/ (accessed May 25, 2024).

[3] Freepik, https://www.freepik.com/search?ai=excluded&format=search&last_filter=query&last_value=&query=&type=photo (accessed May 25, 2024).

[4] Unsplash, “Beautiful free Images & Pictures | Unsplash,” *Unsplash*. https://unsplash.com/ (accessed May 25, 2024).

[5] GeeksforGeeks, “Convert PNG to JPG using python,” GeeksforGeeks, https://www.geeksforgeeks.org/convert-png-to-jpg-using-python/ (accessed May 25, 2024).

[6] “How to resize all images in a folder using Python,” Cloudinary, https://cloudinary.com/guides/bulk-image-resize/how-to-resize-all-images-in-a-folder-using-python (accessed May 26, 2024).

[7] “Rename multiple files using Python,” GeeksforGeeks, https://www.geeksforgeeks.org/rename-multiple-files-using-python/ (accessed May 27, 2024).

[8] “Visualization with python,” Matplotlib, https://matplotlib.org/ (accessed May 27, 2024).