COMP 6721 Fall 2023 Project Part 1

Team Name: **NS_13**

Team Members: ***Wenhao Gu, Md Sayeed Abid, Archilkumar Dineshbhai Katrodiya***

Student ID Numbers: 40203004, 40260779, 40270119

Team Member Specializations:

Data Specialist: *Archilkumar Dineshbhai Katrodiya*

Training Specialist: *Wenhao Gu*

Evaluation Specialist: *Md Sayeed Abid*

Project Repository Link: [GitHub]

Dataset Name: FER-2013

Overview of Existing Datasets:

A collection of 48x48 pixel grayscale portraits of faces is called FER-2013 [1]. Preprocessing was done on these images to make sure the face is in the center and occupies around the same space in each. Each face in the dataset is assigned one of seven emotions: angry, disgusted, afraid, pleased, sad, surprised, or neutral. The dataset is used for facial expression detection.

Special Characteristics of the FER2013 Dataset:

1. **Emotion Diversity:** The dataset has seven different categories that represent a broad range of emotions. This diversity enables the creation of models that can discern between different emotional states in facial expressions.
2. **Large Training Set:** 28,709 samples make up the training set, which offers a big quantity of data for developing emotion recognition models. Model accuracy increases with a larger training set.
3. **Public Test Set:** The existence of a unique public test set with 3,589 examples allows for the evaluation of model performance on a separate dataset, which aids in examining the generalization capabilities of the trained models.
4. **Grayscale Images:** In comparison to color photographs, the grayscale dataset simplifies data preparation and reduces computational work. Grayscale photographs are commonly used for emotion identification tests because they concentrate on facial features while omitting the color dimension, which may not be as crucial for emotion detection..

Justification for Dataset Choices:

FER-2013 [1] is relevant to our work, which focuses on facial emotion recognition. The dataset's features, such as constant image size and emotion labels, make it helpful for training and evaluating emotion recognition programs. Furthermore, the dataset encompasses a wide spectrum of emotions and is large enough to support machine learning studies successfully.

Dataset Name: Student engagement

Overview of Existing Datasets:

This collection has a total of 2120 pictures. It is divided into two classes: engaged and not engaged, with six subclasses (Engaged-Confused, Engaged-Engaged, Engaged-Frustrated) and six subclasses (Not Engaged-Looking away, Not Engaged-Bored, Not Engaged-Drowsy). During training, however, we only choose the

Engaged-Engaged and Not Engaged-Bored subclasses, which have 347 and 358 photos, respectively. And data augmentation will be done after work.

Special Characteristics of the Hypothetical Dataset:

1. **Image Variety:** The dataset's images display a variety of manifestations of student attention and disengagement, including backgrounds, lighting conditions, and facial expressions. This diversity increases the model's robustness in real-world situations.
2. **Frontal Face Shots:** It is important to capture students' engaged faces in a direct, natural way, as demonstrated by the 347 frontal face shots from the "Engaged" class. This may prove advantageous in developing a model to detect constructive engagement.
3. **Diverse Emotions:** The "Confused," "Frustrated," "Looking away," "Bored," and "Drowsy" subclasses contain images that depict a range of emotions and facial expressions, which aid in the model's development of the capacity to distinguish subtle differences between various states.

Justification for Dataset Choices:

The dataset is crucial because it could contribute to the development of an automated technique that will greatly benefit facial detection, identifying student involvement in online classes. Teachers want to be sure their students are paying attention in class and understanding the material, so this dataset is relevant.

A variety of facial emotions are represented in the dataset, ranging from joyful expressions of engagement to disgruntled ones like confusion and irritation. This diversity is necessary to develop a model that can accurately distinguish between these different emotional states.

Furthermore, this dataset captures the true dynamics of remote learning, as students experience mood swings ranging from high engagement to apathy while glued to their screens. As such, it provides a realistic representation of the emotions that students express during their online learning experience, which makes it an valuable tool for the development of educational technology.

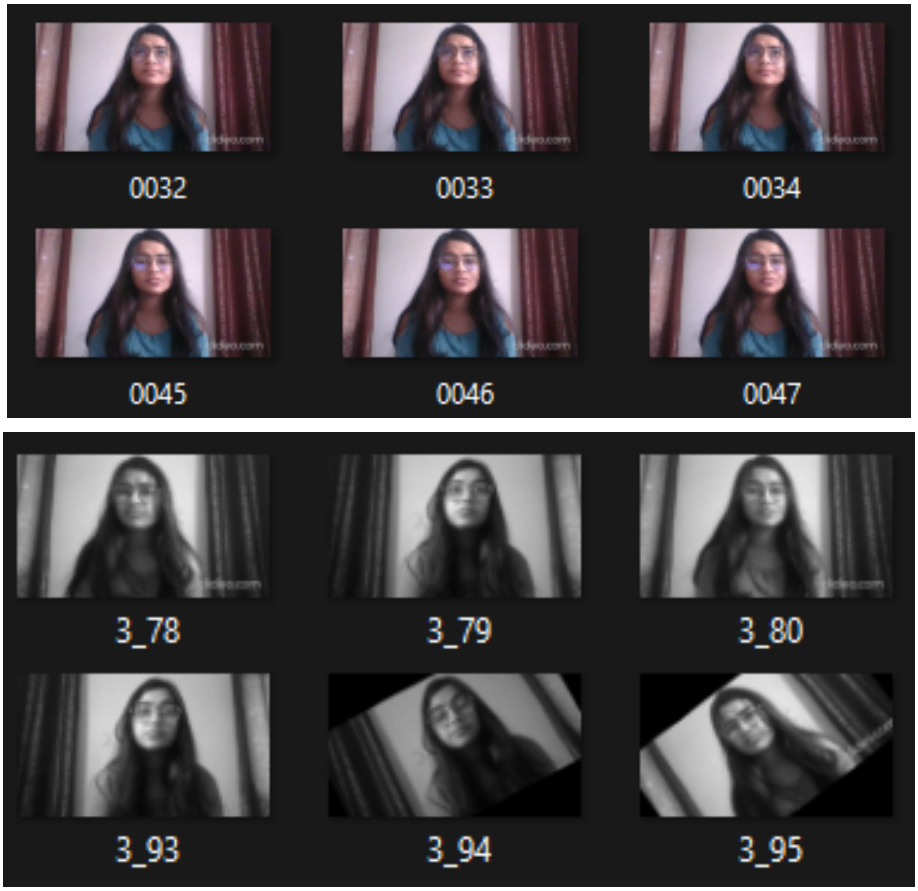
Provenance Information:

classes	images	Image Source	Licensing Type	Relevant Information
Neutral:	2631	FER-2013 Dataset	Publicly available	The dataset can be accessed at kaggle

Engaged/Focused:	1719	Student Engagement	Publicly available	The dataset can be accessed at kaggle
Bored/Tired:	1669	Student Engagement	Publicly available	The dataset can be accessed at kaggle
Angry/Irritated:	2949	FER-2013 Dataset	Publicly available	The dataset can be accessed at kaggle

Data Cleaning

1. As described, we collected our data from 2 different sources. So, the dataset was quite different from each other. In terms of size, they were very different. Two of the classes had images with a dimension of 48x48, and the other two classes had dimensions of 1280x720. So, we resized every image to 48x48 to make the dataset balanced. To maintain symmetry among the dataset, we augmented the bored and engaged classes of the dataset, which had very few images compared to the other two classes. These classes had colored images, but the other two classes had grayscale images, so first, we turned all the images into grayscale images. To do that, we used cv2.COLOR_BGRTOGRAY from OpenCV. After that, we did brightness correction and then added some rotation to incorporate some variability in the dataset. For this process, we also used some packages from OpenCV.
2. There were some out-of-class images in neutral and angry class, which has been eliminated to make the dataset ideal. As these out-of-class images were totally randomized, we couldn't find any way to automatically eliminate these images. So, we had to eliminate them manually, one by one.

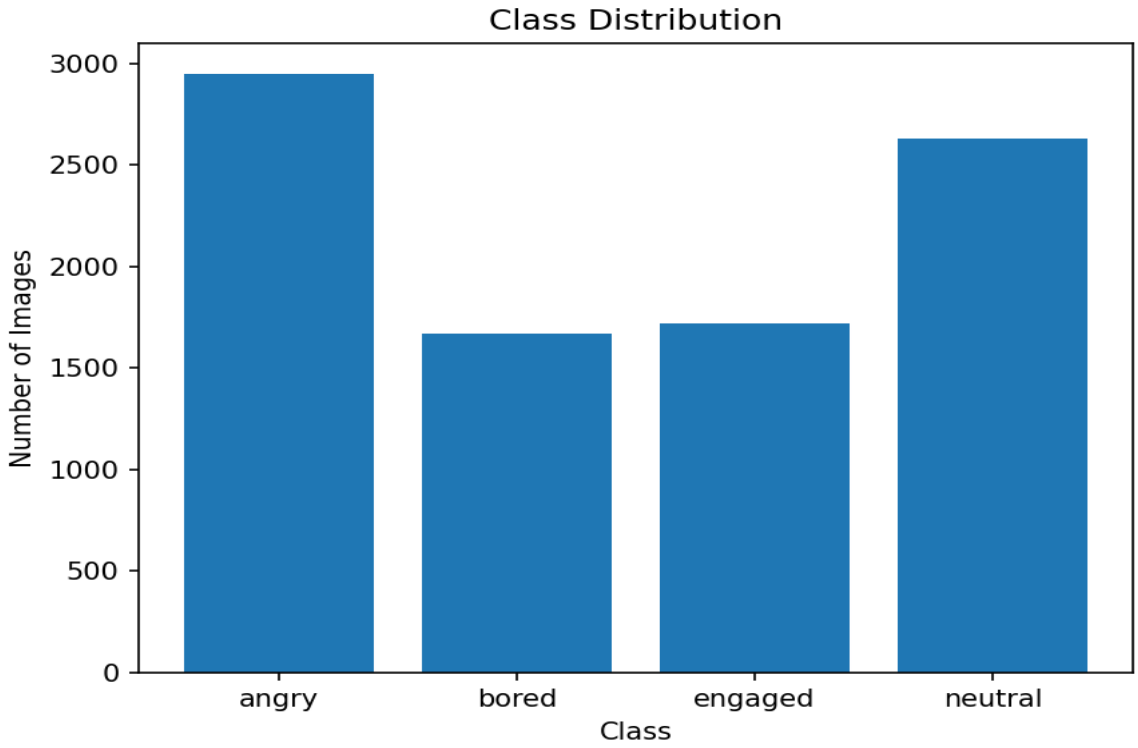


Labeling

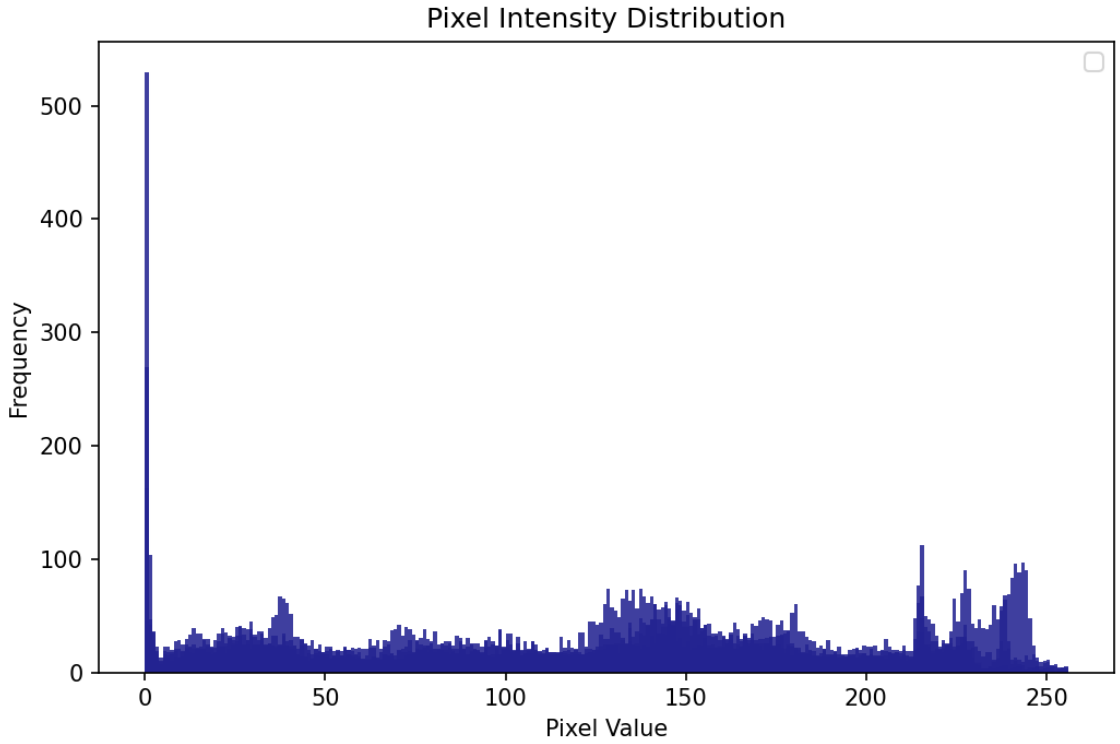
1. Finding the exact classes for the dataset was the biggest challenge, as we couldn't find any standardized dataset which has all the required classes for our project. So, to create our dataset, we merged 2 different datasets. We took two classes from the FER2013 [1] dataset and two classes from the Student Engagement [2] dataset. Among the two classes of the Student Engagement [2] dataset, we merged several classes of that dataset together to create our "Engaged" and "Bored" classes.
2. Though the images were pre-labeled, we performed various classes together to achieve our standardized dataset, so there were many gaps in the labels. Moreover, as there were two different datasets used, the labeling was different. So, after all the data cleaning process and splitting were done, we labeled our data. To label our data, we serialized the classes with a unique integer number, and each image in that class was serialized accordingly. Suppose the class label is X, and the image serial is y; then the image label will be X_y. To achieve this task, we ran a simple Python script, which created the labels of our dataset accordingly.

Dataset Visualization:

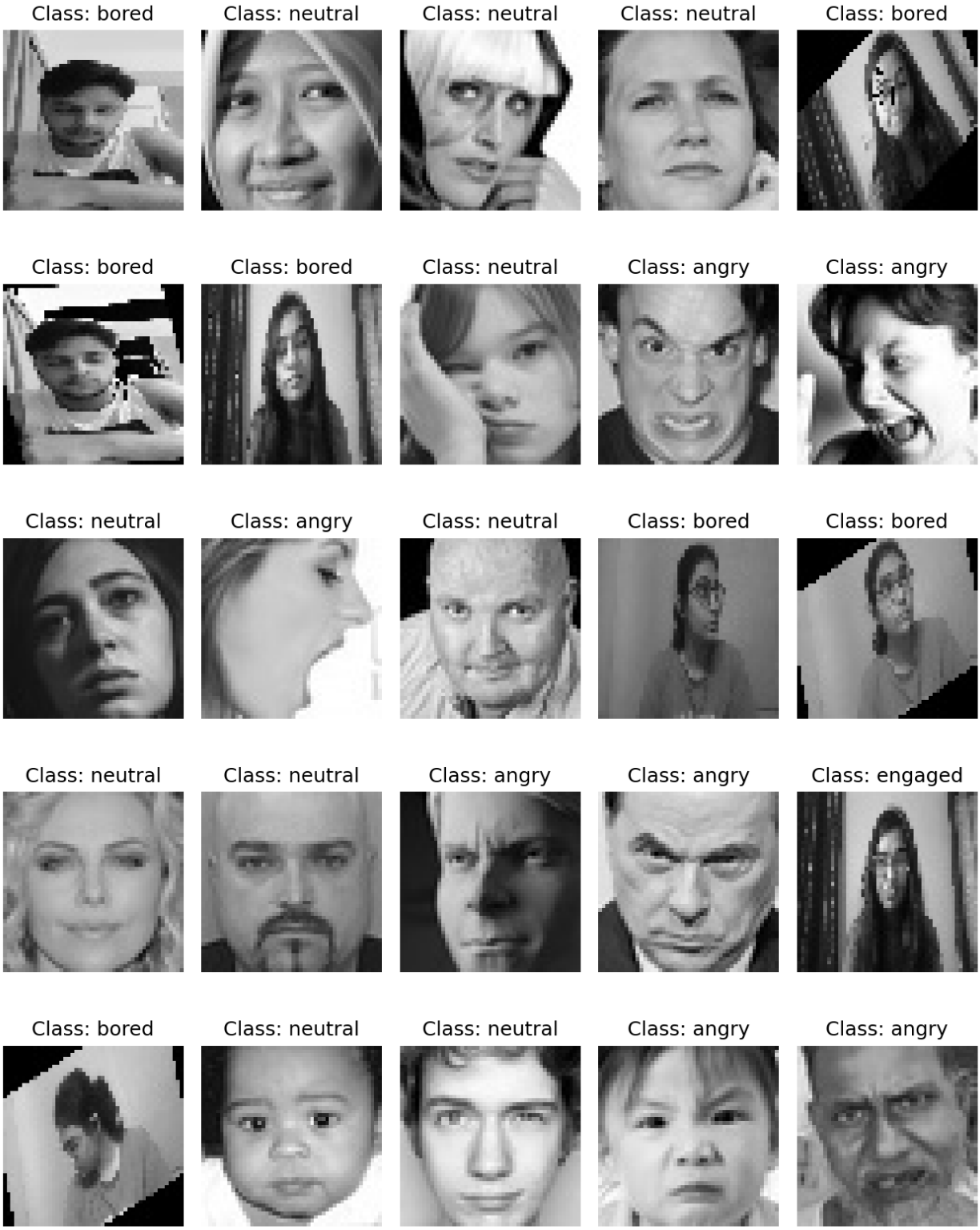
Class Distribution:



Pixel Intensity Distribution:



Sample Images:


Class: bored
Class: neutral
Class: neutral
Class: neutral
Class: bored
Class: bored
Class: bored
Class: neutral
Class: angry
Class: angry
Class: neutral
Class: angry
Class: neutral
Class: bored
Class: bored
Class: neutral
Class: neutral
Class: angry
Class: angry
Class: engaged
Class: bored
Class: neutral
Class: neutral
Class: angry
Class: angry

Reference

[1] Sambare, M. (n.d.). FER-2013 [Dataset; Kaggle]. In Learn facial expressions from an image (Version 1). https://www.kaggle.com/datasets/msambare/fer2013/data

[2] Dey, J. (n.d.). Student-engagement [Dataset; Kaggle]. In predict student engagement in online classes (Version 1). https://www.kaggle.com/datasets/joyee19/studentengagement