Application of Facial Emotion Detection in E-Learning

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Problem Definition

▶ E-Learning / Online education has been consistently growing since 1980, and drastically after COVID-19.

▶ The main problem of E-Learning is the lack of personability.

▶ Different methods of emotion detection can help with monitoring student emotions during E-Learning.

Problem to Solve

▶ What kind of model with its deep learning specifications can detect facial emotions effectively?

▶ What type of privacy and transparency legalities need to be explored in order to gather and apply data?

▶ What are the combinations of emotions that can denote learning-related emotions.

▶ How can we promote the usage of these tools to improve quality and accessibility of E-Learning?

Solution Approach

▶ Exploratory Data Analysis
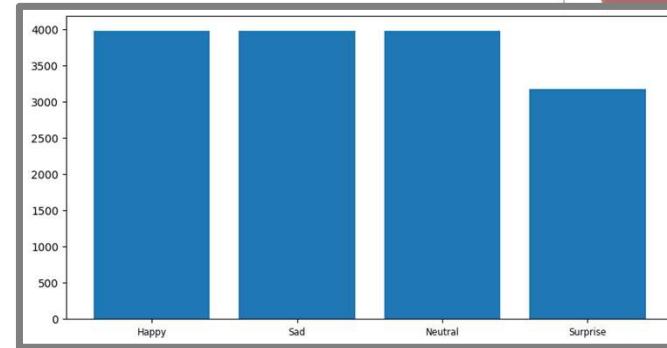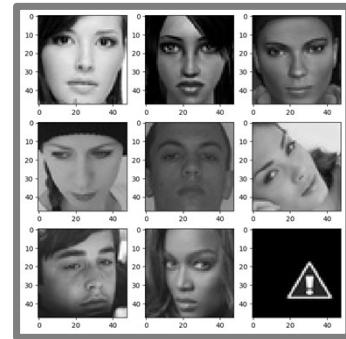
▶ Exploring different models

▶ Tuning hyperparameters of promising models

▶ Choosing the best model
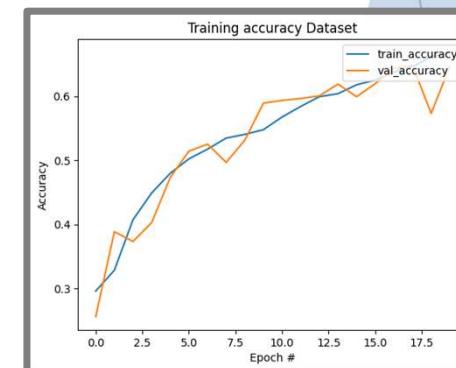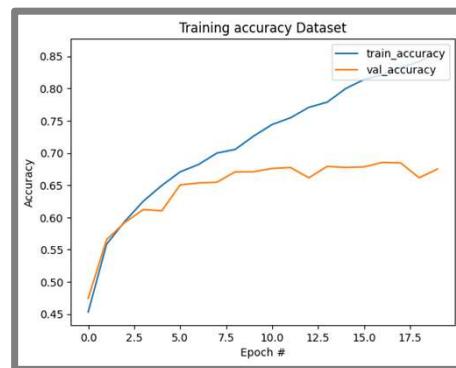
Proposed Model Solution

▶ Complex Neural Network Architecture (Complex CNN) was chosen to detect facial images.

    ▶ Extracts features using convolutional layers

    ▶ Trainable at all layers

    ▶ Stabilizes and adjusts as it goes

Model Description	Weighted AVG f-1 Score
Simple CNN #1	21%
Simple CNN #2	28%
VGG	32%
ResNet	10%
EfficientNet	10%
Complex CNN #1	52%
Complex CNN #2	71%
Complex CNN #3	71%
Complex CNN #4	78%
Complex CNN #5	78%

Final Model Solution

▶ Complex Neural Network Architecture #5 had the best performance.

▶ Weighted AVG f-1 score was used as the evaluation metric.

▶ Hyperparameters were tuned to reduce overfitting and stabilize the training process.
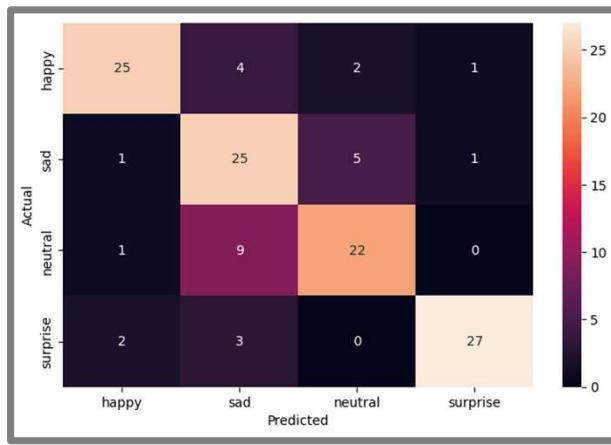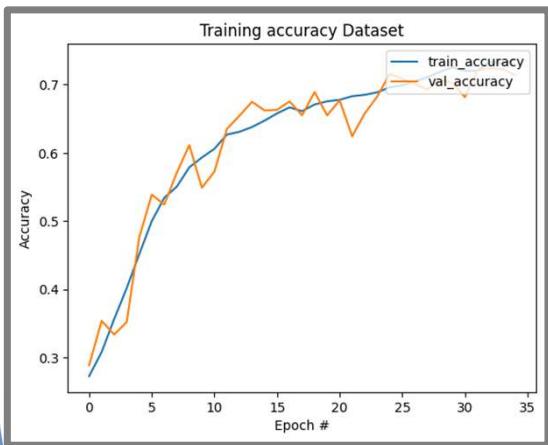
Emotion	Precision	Recall	F-1 Score
Happy	0.86	0.78	0.82
Sad	0.61	0.78	0.68
Neutral	0.76	0.69	0.72
Surprise	0.93	0.84	0.89
Accuracy			0.77
Macro AVG	0.79	0.77	0.78
Weighted AVG	0.79	0.77	0.78

Proposed Business Solution

▶ Invest time and resources to develop facial emotion detection, so student emotions can be perceived during online instruction.

▶ Further the research, then integrate the model with emotion detection models from voice, gesture, and text.

▶ Deliver more personalized, accessible, and higher-quality E-Learning.

▶ Investigate the legality of gathering more data ethically and transparently.
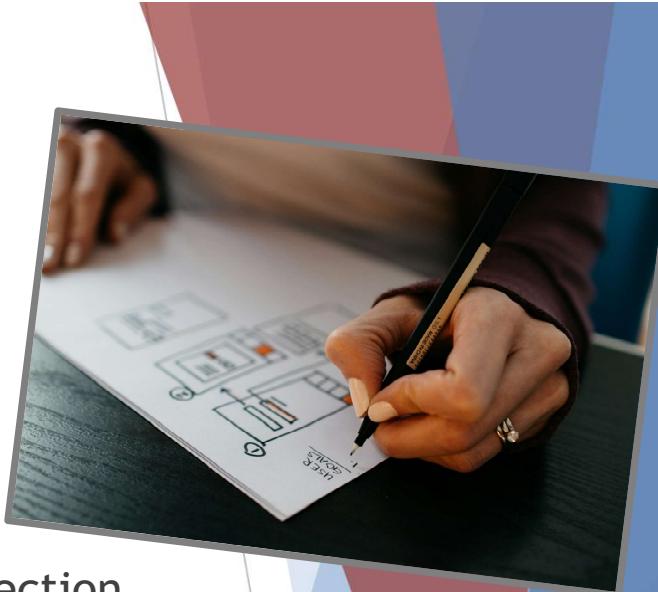
Executing Business Solution

▶ Invest in the data science team to continue developing models and also look into how the model can detect learning-related emotions.

▶ Develop a legal team for ethically gathering data and applying models.

▶ Update hardware to meet the demands of deep learning.

▶ Continue building relationships with schools that can help with implementing detection models and and promote usage.

Executive Summary

▶ Complex Neural Network Architecture can detect facial emotions from images with appropriate layers and tuning.

▶ Both the use and the revenue involved in E-Learning will continue increasing.

▶ Further research and implementation will result in more personalized E-learning experience for students.

▶ With careful approach to privacy and transparency, the industry will benefit from a world-wide demand and investment in emotion detection features in E- Learning.

Risks and Challenges in Emotion Detection

▶ Risks

  ▶ High upfront costs with establishing teams of data scientists, researchers, and lawyers

  ▶ Legality of obtaining images and video clips of students

▶ Challenges

  ▶ Obtaining a large, diverse, and quality dataset

  ▶ Hardware requirements

  ▶ Unwilling participants – schools, teachers, students, parents

  ▶ How to detect emotions in learning from basic emotions
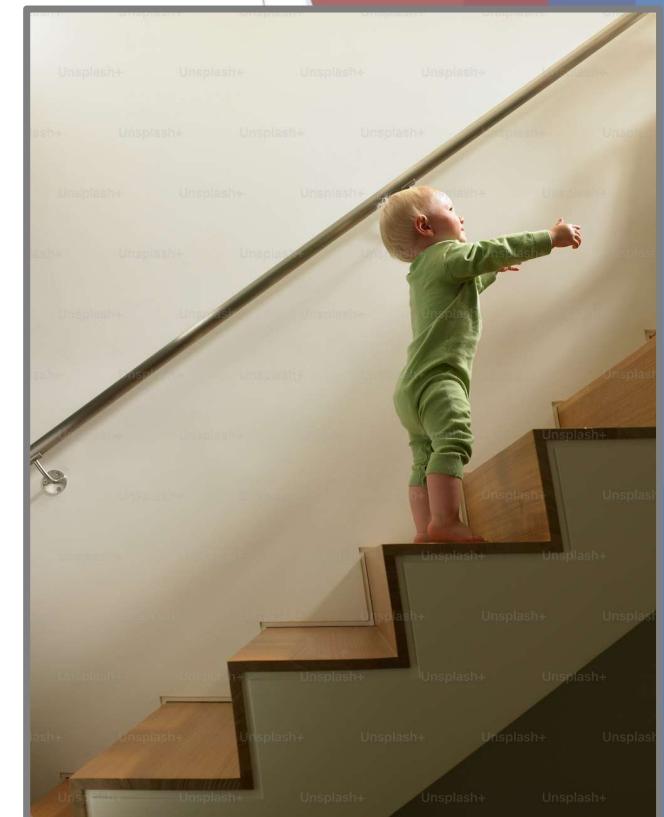
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