Capstone Project - 5

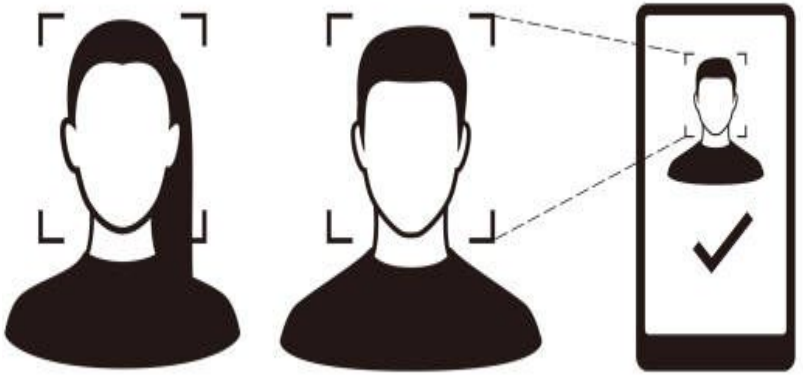
Deep Learning + ML Engineering

FACE EMOTION RECOGNITION

- *Avisikta Majumdar*
- *Arkopravo Pradhan*

Contents

- Problem Statement
- Data Summary
- Dependencies
- Model Creation
- Model Evaluation
- Build and Deployment of Web App
- Realtime Face Emotion Recognition Demo
  - Challenges
  - Conclusion



Face Emotion Recognition

PROBLEM STATEMENT

- The Indian education landscape has been undergoing rapid changes for the past 10 years owing to the advancement of web-based learning services, specifically, eLearning platforms.

- Global E-learning is estimated to witness an 8X over the next 5 years to reach USD 2B in 2021. India is expected to grow with a CAGR of 44% crossing the 10M users mar in 2021. Although the market is growing on a rapid scale, there are major challenges associated with digital learning when compared with brick and mortar classrooms. One of many challenges is how to ensure quality learning for students. Digital platforms might overpower physical classrooms in terms of content quality but when it comes to understanding whether students are able to grasp the content in a live class scenario is yean open-end challenge. In a physical classroom during a lecturing teacher can see the faces and assess the emotion of the class and tune their lecture accordingly, whether he is going fast or slow. He can identify students who need special attention Digital classrooms are conducted via video telephony software program (ex-Zoom) where it's not possible for medium scale class (25-50) to see all students and access the mood. Because of this drawback, students are not focusing on content due to lack of surveillance.

- While digital platforms have limitations in terms of physical surveillance but it comes with the power of data and machines which can work for you. It provides data in the form of video, audio, and texts which can be analyzed using deep learning algorithms. Deep learning backed system not only solves the surveillance issue, but it also removes the human bias from the system, and all information is no longer in the teacher's brain rather translated in numbers that can be analyzed and tracked. I will solve the above-mentioned challenge by applying deep learning algorithms to live video data. The solution to this problem is by recognizing facial emotions.

Data Summary

- I have built a deep learning model which detects the real time emotions of students through a webcam so that teachers can understand if students are able to grasp the topic according to students' expressions or emotions and then deploy the model. The model is trained on the FER-2013 dataset .

- This dataset consists of 35887 grayscale, 48x48 sized face images with seven emotions - angry, disgusted, fearful, happy, neutral, sad and surprised.
- Here is the dataset link:
- https://www.kaggle.com/msambare/fer2013

Data Summary

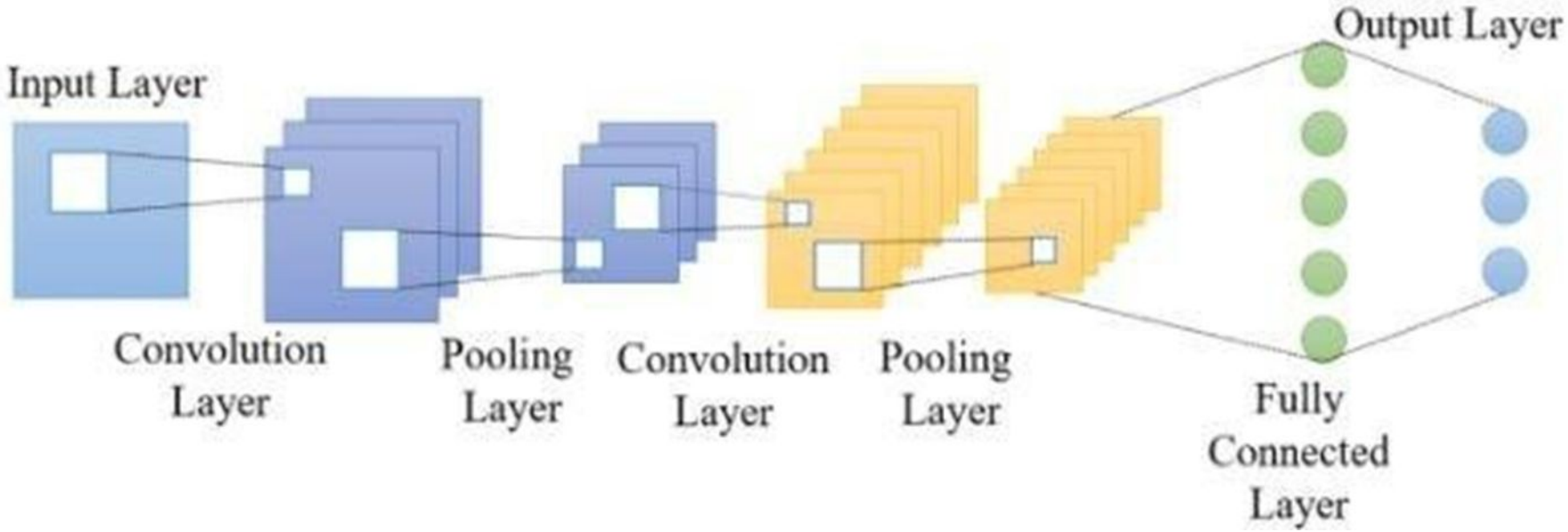
- Each image corresponds to a facial expression in one of seven categories (0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral). The dataset contains approximately 36K images.
- Data is converted into raw images and spitted them in multiple folders.

Label	Emotion	Number of images for Training	Number of images for Testing
0	Angry	3995	958
1	Disgust	436	111
2	Fear	4097	1024
3	Happy	7215	1774
4	Sad	4830	1247
5	Surprised	3171	831
6	Neutral	4965	1233

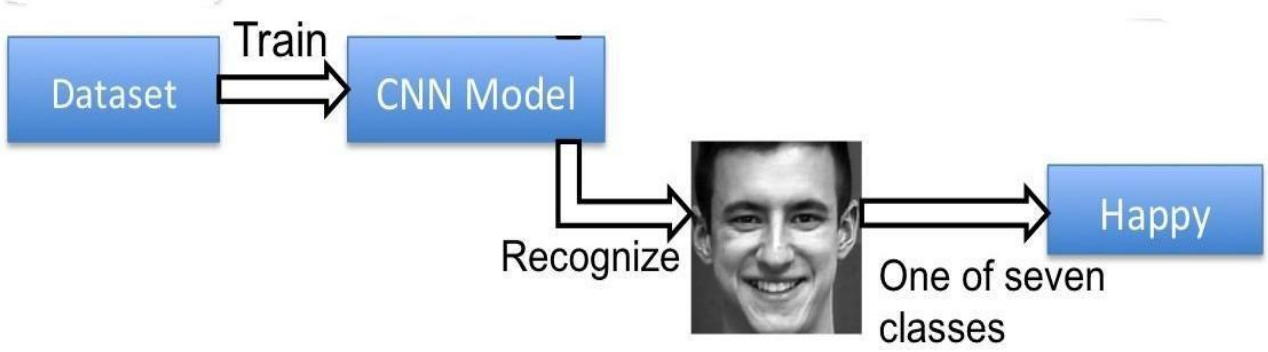
DEPENDENCIES

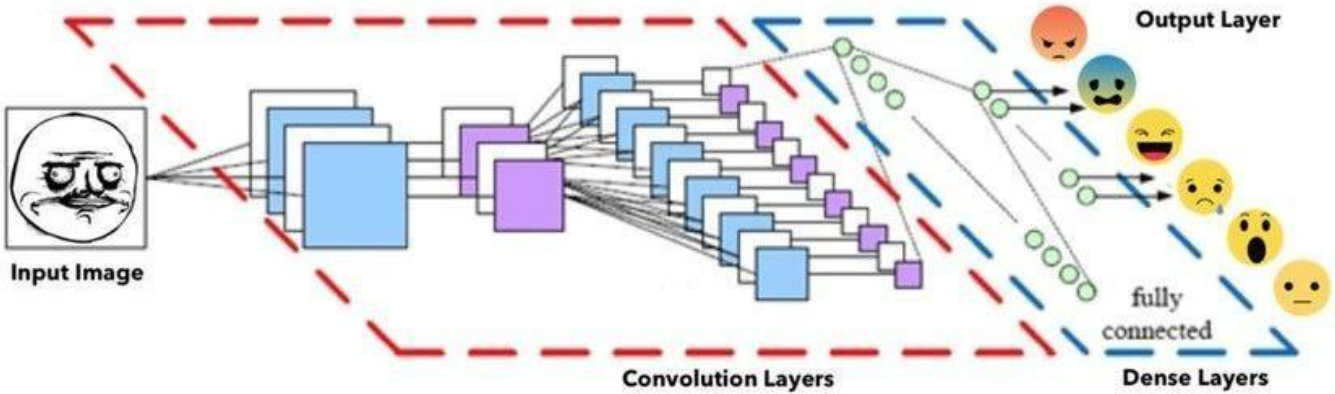
- ***Python3***: – Language we have used to solve this problem statement
- ***Streamlit:*** – To build the web application
- ***Streamlit-Webrtc :*** – To access the web app camera on website
- ***Keras :*** – To build the CNN model
- ***OpenCv :*** – To put rectangle & text on the face

Building Model : CNN layers



Building Model : CNN layers





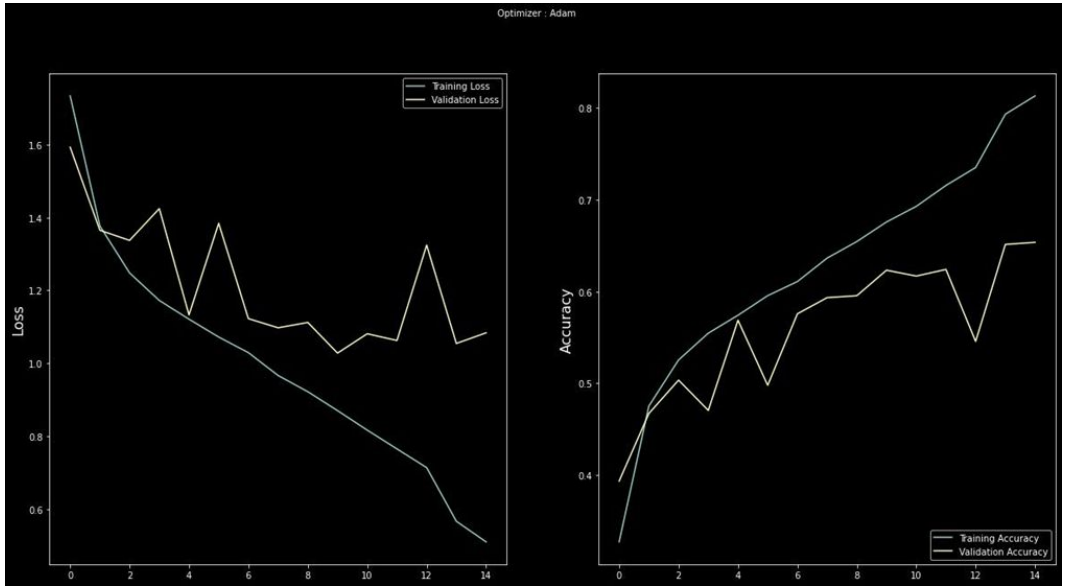
Building Model : CNN Model

- Parameters
  - Activation Function - ReLu, SoftMax
  - Epoch - 40
  - Optimizer - Adam
  - Batch size -32
- Also we use some common techniques for each layer
  - Batch normalization
    - Pooling
  - Dropout

We choose SoftMax as our last activation function as it is commonly used for multi-label classification.

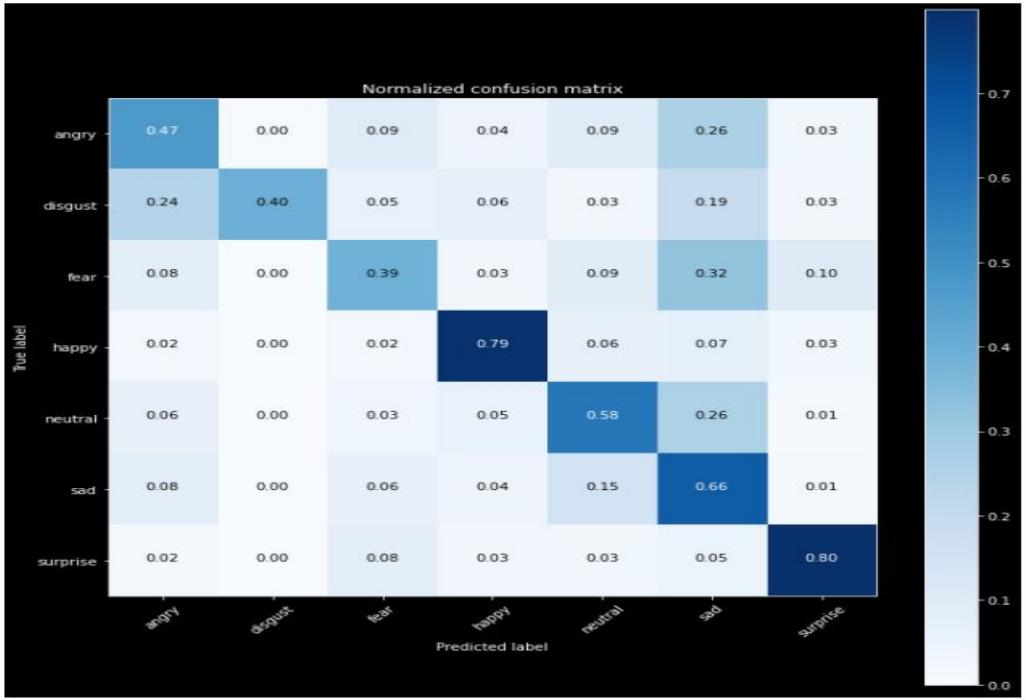
Model Evaluation

- The training gave the accuracy of 84.9% and val_accuracy of 65.8%. It seems good. So, I save the model and detection I got from live video is good.
- The training loss is slightly higher than the validation loss for the first epochs.



Output

- Our model is very good for predicting happy and surprised faces.
- It predicts quite poorly feared faces maybe because it confuses them with sad faces.



Creating Web App Using Streamlit

- Streamlit is an open-source python framework for building web apps for Machine Learning and Data Science. We can instantly develop web apps and deploy them easily using Streamlit. Streamlit allows you to write an app the same way you write a python code. Streamlit makes it seamless to work on the interactive loop of coding and viewing results in the web app.

Application Link: - *https://share.streamlit.io/avisikta-majumdar/capstone-project-face-emotion-recognition/main/app.py*

Creating Web App Using Heroku

- Heroku is a cloud platform as a service supporting several programming languages. One of the first cloud platforms, Heroku has been in development since June 2007, when it supported only the Ruby programming language, but now supports Java, Node.js, Scala, Clojure, Python, PHP, and Go.

Application link : - https://face-emotion-almabetter.herokuapp.com/

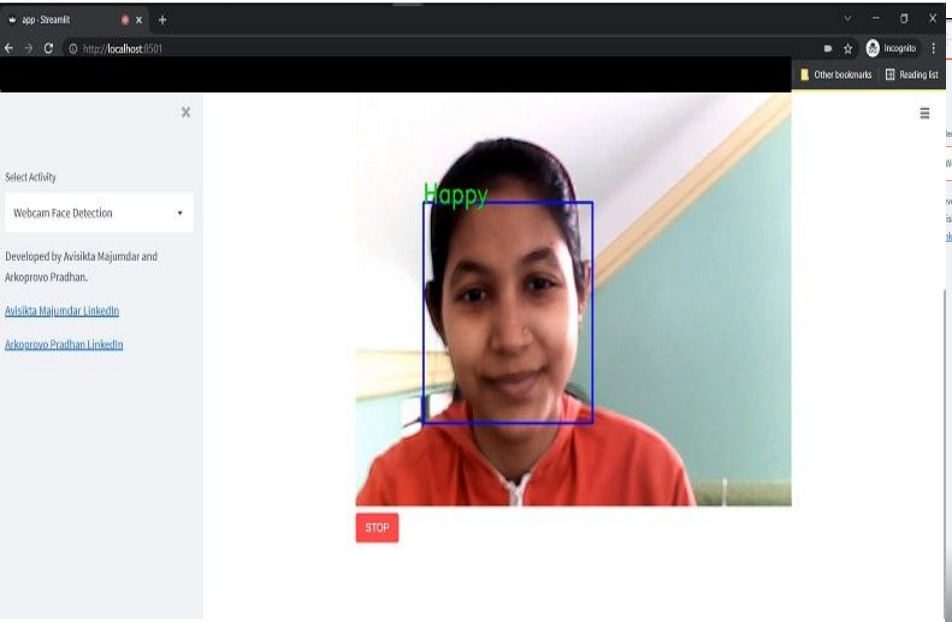
Challenges

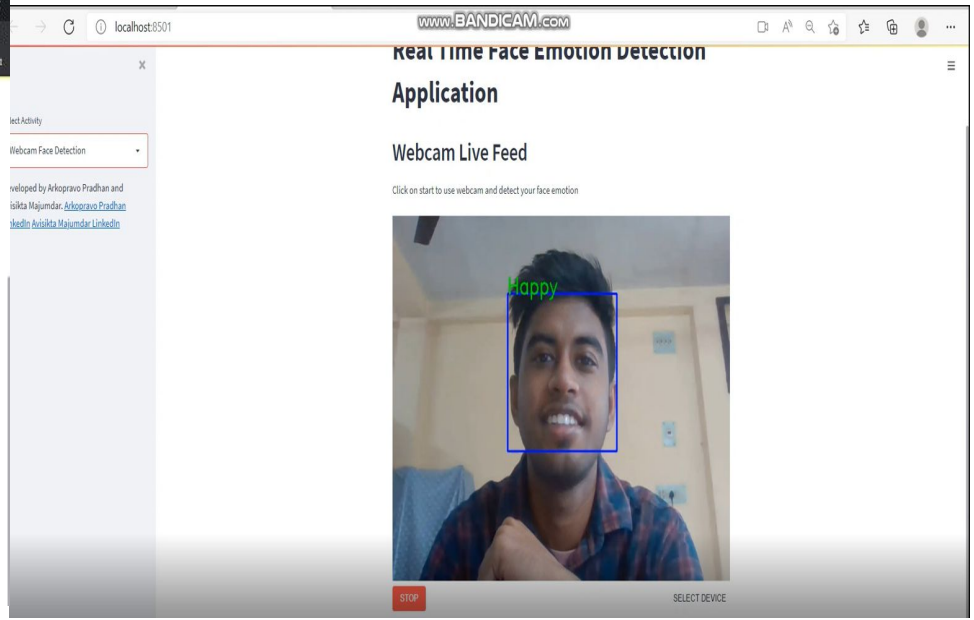
- Large dataset folder containing lot of images to handle
- Model training take lots of time and system resource
- Continuous Runtime and RAM Crashes many time till we get the best model
- Code to access webcam using opencv
- Deployment part d

Conclusion

- *Our model is giving an accuracy of 84.9% and validation accuracy of 65.8% . It is robust in that it works well even in a dim light environment.*
- *The application is able to detect face location and predict the right expression while checking it on a local webcam.*
- *The front-end of the model was made using streamlit for webapp and running well on local webapp link.*
- *Finally, we successfully deployed the Streamlit WebApp on Heroku and Streamlit Cloud , that runs on a web server.*
- *And we believe that through this model teachers can understand the students' perception during online classes and change the way of teaching if needed by understanding the students' motive.*

Webcam Live Feed






THANK
YOU