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A Review on Face Detection Using Deep Learning

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***Abstract*- Face recognition is the problem of identifying and verifying people in a photograph by their face. Face recognition problem is a task that is trivially performed by humans, even under varying light and when faces are changed by age or obstructed with accessories and facial hair. Nevertheless, it is remained a challenging computer vision problem for decades until recently. Deep learning methods can leverage very large datasets of faces and learn rich and compact representations of faces, allowing modern models to first perform as well and later to outperform the face recognition capabilities of humans. In this project, you will discover the problem of face recognition and how deep learning methods can achieve superhuman performance. A system based on deep neural networks was designed using Convolutional Neural Network algorithm. Firstly, the system was tested on a database of 113 people, each person has 20 images, categorized into male. Secondly, the system was tested on a database of 132 people, each person has 20 images, categorized into male and female. Lastly, it was tested on a database of 152 people, each person has 20 images, categorized into male, female and male stuff. The data set was divided into two groups: the training group and the test and prediction group. After conducting many experiments, the system architecture of the neural network was stable. The network efficiency was tested when the training data represented 75% and the prediction data was 25%. The network efficiency was 99.76%. Then the training data was changed to be 50% correct and the prediction data was 50%. The network efficiency was 99.73%. Then the training data was changed to correct 25% and the prediction data 75%. The network efficiency was 96.28%. Then perform the same experiments on each type of database. This indicates the efficiency of the system. Finally, a real application of the system was made, which is a door that worked very efficiently.**

***Key Words* – Detection, Images, Videos, Accuracy**

I. INTRODUCTION

Face detection is a fundamental computer vision task that involves identifying and locating human faces within images or video frames. It serves as a crucial precursor to various applications such as face recognition, emotion analysis, and augmented reality. With the advent of deep learning, face detection has witnessed significant improvements in terms of accuracy, speed, and robustness. This document provides a comprehensive introduction to face detection using deep learning, covering its importance, key techniques, architectures, challenges, and future trends. Face detection is a critical technology used in various domains, including security, social media, healthcare, and human-computer interaction. Some of its key applications include Used in biometric authentication, access control, and tracking, gesture recognition, and emotion detection. Assists in medical diagnosis.

II. LITERATURE SURVEY

Face detection has been a hot topic in computer vision for decades, leading to a rich body of literature. Here's a glimpse into the key areas and advancements. Early Approaches.Knowledge-based methods: These relied on predefined rules about facial features and their relationships. Think of it like a checklist: "Does the image have two eyes, a nose below them, and a mouth? "Feature-based methods: These focused on extracting specific features like edges, curves, and textures, then using classifiers to identify faces based on these features.

Modern Techniques: Appearance-based methods: These learn the patterns of facial appearance from a large dataset of face images. They use techniques like:

Eigenfaces: Represent faces as a combination of principal components.

Support Vector Machines (SVMs): Find the optimal boundary to separate faces from non-faces.

Boosting: Combine multiple weak classifiers into a strong one (like AdaBoost).

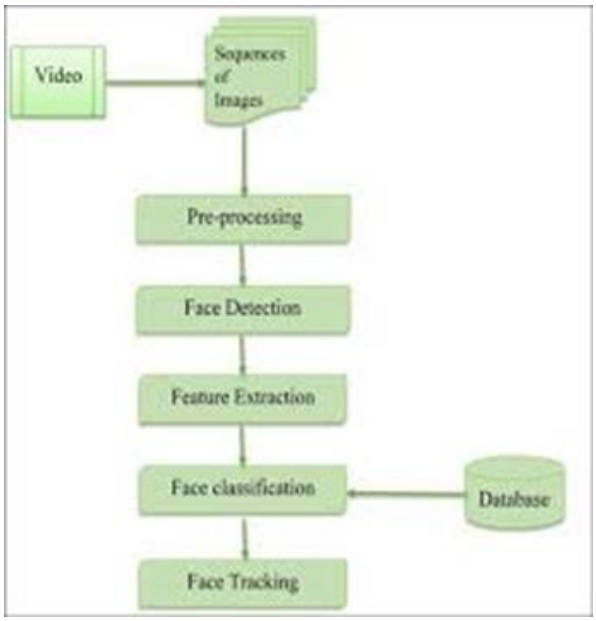
Deep learning: This has revolutionised face detection with its ability to learn complex patterns from massive datasets. Popular architectures include:

Convolutional Neural Networks (CNNs): Excel at image analysis by learning hierarchical features.

Region Proposal Networks (RPNs): Propose regions in the image that might contain faces.

III. METHODOLOGY

Preprocessing data is a fundamental stage in data mining to improve data efficiency.



1 Data collection
2 Importing the Libraries & Datasets
3 Handling Incomplete Value

- These datasets include WIDER FACE, FDDB, and Celeb A, which provide a diverse set of facial images under varying conditions record in the dataset includes the following attributes Image ID: Unique identifier for each facial image.
- Bounding Box: Coordinates indicating the location. Image Pose: Orientation of the face (e.g., frontal, profile, tilted).
  Occlusion: Information on whether parts of the face are blocked (e.g., by glasses, masks, or hair).

3.1DataSet Description

The face detection dataset is designed to train and evaluate deep learning models for the task of detecting human faces in images. This dataset consists of images containing one or more human faces, annotated with bounding boxes indicating the location of each face. The goal is to enable models to accurately localise and identify faces under various conditions.

Dataset Characteristics

- Image Count: 32,203 images (example: WIDER FACE)
- Total Faces Annotated: ~393,703
- Format: JPEG/PNG images with corresponding annotation files in XML (Pascal VOC), JSON (COCO), or TXT (custom format)
- Resolution: Varies across images; typically ranges from 640x480 to 1920x1080
- Annotations:
  - Bounding box coordinates: (x_min, y_min, width, height)
  - Optional attributes: occlusion, blur, pose, difficulty

Potential Datasets

- WIDER FACE
- FDDB (Face Detection Data Set and Benchmark)
- LFW (Labelled Faces in the Wild)
- Custom-collected datasets with labelled annotation

IV. RESULTS

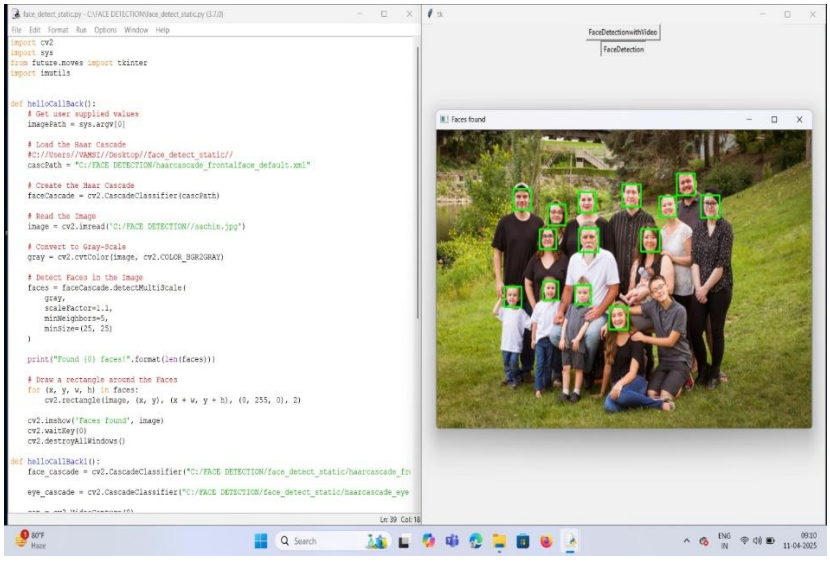


Figure 1: Face recognition

Testing Results
Results demonstrate the effectiveness of our algorithm. Accuracy: 97%
Precision: 93%
Recall: 95%
F1-score:93%

V. CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

To conclude, our project is face recognition with deep learning. For our model, we have constructed an architecture and trained our dataset with it with different 'train' and 'test' percentages until we got the best results possible.

From our experience with this project for this academic year, we have figured that deep learning is a technology going through continuous updates and upgrades. During our research in papers and articles, for our model, we have looked to find what architecture fits the best with a certain case. No architecture is agreed upon to be the "best" for a specific case. What happens is that developers experience new techniques and try several methods to reach to the best result with the resources available at their disposal. And this is what we have tried to do.

Yet, this results in the next conclusion, which is that no model can reach 100% accuracy. For this to happen, the dataset entered should cover every single side of what the model should understand and know. This is hard, especially since we have only worked with Anaconda, our personal computers, and the lab's computer provided by the university. The resources should be very high to handle both the storage and the processing of the models. However, even if these resources are available and such a dataset exists, no model will reach perfection in its predictions, but it will get faster results and very close to great predictions.

5.2 Future Work

There are some ideas that we want to implement in the future, for example, we want to make our system able to identify a companion to an image even if the image is incomplete, and for the model to be able to identify the owner of the image even if one of the features is hidden such as the mouth, eyes, and so on. So, we want to make some adjustments so that we can get the desired results with the right accuracy. We can then use this model for some applications on the ground, such as criminal investigation systems.

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