A Project Report On

"Face Recognition"

B. Tech CSE (ML and AI)

Graphic Era (Deemed to be University)

Dehradun

Compiled by:

Prabhat Malhan

2015257

Under the guidance of:

Dr Vishen Gupta

(Project Mentor)

Graphic Era (Deemed to be University), Dehradun

June 2022

ABSTRACT

Face the front part of the head, with the eyes, nose, and mouth. But there is more to a face than just these physical features. There are actually many different attributes that make up a face, and these can vary from person to person. These differences might seem small, but they can have a significant impact on how a person is recognized.

Face can be used in information security, which is defined by its three major objectives namely confidentiality, integrity, and availability. A comprehensive approach is required for implementing these objectives to ensure consistency in an ever-changing environment. This is the top reason for cybersecurity issues due to unsolved gaps in operational security policies and protection on both site and device levels.

The security of personal data in computers is an issue that finally is gaining the required concern. With advances in technology, malicious hackers are getting new ways to break into computers and steal personal information. One such method is the biometric authentication either by fingerprint, retina, or the face itself. The project introduces an application using computer vision for Face recognition. A camera records a live video stream which is then send for processing and prediction in the browser. The system can recognize **13 different faces** through a custom-made dataset.

Experiments conducted on multiple combinations of the hidden layers in the **Convolutional Neural Network (CNN)** that could best differentiate a face inferred that the CNN with **9 hidden layers** gave highest accuracy rate. In the preprocessing phase, a self-developed algorithm extracts the face in each data image and optimizes it for further processing. After the conversion that image passed to the CNN model for differentiating and classifying different faces.

Previous systems used contours of OpenCv for the prediction. This project has no such constraints for using the system. The user can face the camera naturally through browser interface for authentication. A completely robust face recognition system is still under heavy development. The implemented system might set up the basic of extensive biometric authentication in near future.

When the model trained training data for an accuracy of 93% and validation of 97%, whereas the test data results conclude that the accuracy of the model is 96.66%.

INTRODUCTION

Biometric authentication is a security measure that uses a physical characteristic of a person, such as their fingerprint, to verify their identity. This type of authentication is more secure than traditional methods, such as a password, because it is much more difficult to spoof.

Face detection is an important process which started more than 8 decades back. It compares photos in the database and identifies people based on facial characteristics. Face detection is a crucial part of biometric authentication to verify a person's identity.AI has been aiding face detection for many years now. It can use methods like object recognition and optical character recognition to detect faces and read numbers et al from drivers' licenses or other IDs to verify someone's identity.

Face detection is an important security measure because it is more difficult to spoof than other methods, such as a password. This makes it more secure and less likely to be compromised. Face detection can also be used to verify the identity of a person before allowing them to make a transaction, such as a purchase or a money transfer. This prompted my interest so I planned to make a project that could recognize human face through computer vision, which is a sub field of artificial intelligence. The purpose of my software is to extract and detect the features present in an image.

A first step in any face recognition system is to detect and localize face in an image. The face detection task was however challenging because of variability in the pose, orientation, location, and scale. Also, different lighting conditions add further variability. Image processing is one of the most extensively involving software industry with its applications in all the aspects of life. It holds the possibility of developing the ultimate machines in future, which would be able to perform the visual function of living beings. As such, it forms the basis of all kinds of automation based on the computer vision.

FACE DETECTION

Face detection is locating of the presence of a face in a still image or sequence of images i.e., videos. In case of videos, it can be followed by tracking the face frame-by-frame, but this is more relevant to the applications where security is priority. The underlying concept of face detection is that human eyes can detect objects in the images which machines cannot with that much accuracy as that of a human. From a machine point of view, it is just like a man roaming around clueless to find the object in place.

The factors responsible for the correct face detection are:

- **Pose and Alignment of the face**
- **Clarity in the background**
- **Lighting conditions while detection**

SCOPE AND OBJECTIVES OF PROJECT

The scope of the project is to detect the class of the image data given to us through camera input. We need to learn about multiple Machine Learning Models, their working, and a language to implement them.

In this project we had to build a real time face classification system that can automatically recognize the face in natural lighting condition. To accomplish this objective, a real time system is developed to identify human faces

This system will work as one of futuristic of Artificial Intelligence and computer vision with user interface. It creates a method to recognize face based on different parameters. The main priority of this system is to simple, easy and user friendly without making any special hardware. All computation will occur on single PC which has GPU (**GeForce RTX 2060**) available. Only special hardware will use to digitize the image (Webcam).

The objectives of this project include:

1. Creating a system which can recognize people by their faces using computer vision and machine learning
2. To provide a high speed and color image processing system.

MOTIVATION

Personal data has developed into a business game changer over the past few decades. However, it also fuels modernization efforts and with rise of automatized economy its bound to shape development of county digitally too if we stay vigilant against threats like frauds, ransomwares etc. Thus, paying attention towards IT security should be a priority not only of individuals but also organizations if they want to remain integrated in their digital transformation journey and leverage the benefits offered by latest technological innovations that offer exclusivity. Hence it has become a necessity to protect this data from unauthorized access, this is where the face recognition comes into play.

There are many benefits of using face detection for security and access control. First, it is more accurate than other methods, as it can more easily identify individuals even if they are trying to disguise themselves. Second, it is more dependable, as it is less likely to be fooled by things like glasses or facial hair. Third, it is more convenient, as users do not need to remember PINs or passwords. Face detection is also becoming more popular for use in consumer electronics, such as smartphones and laptops. This is because it is more secure than other methods, such as password or PIN entry. Additionally, it is more convenient for users, as they can simply look at their device to unlock it. Overall, face detection is a valuable biometric authentication tool that offers many benefits over other traditional methods. It is more accurate, dependable, and convenient, making it ideal for use in security and access control applications.

METHODOLGY

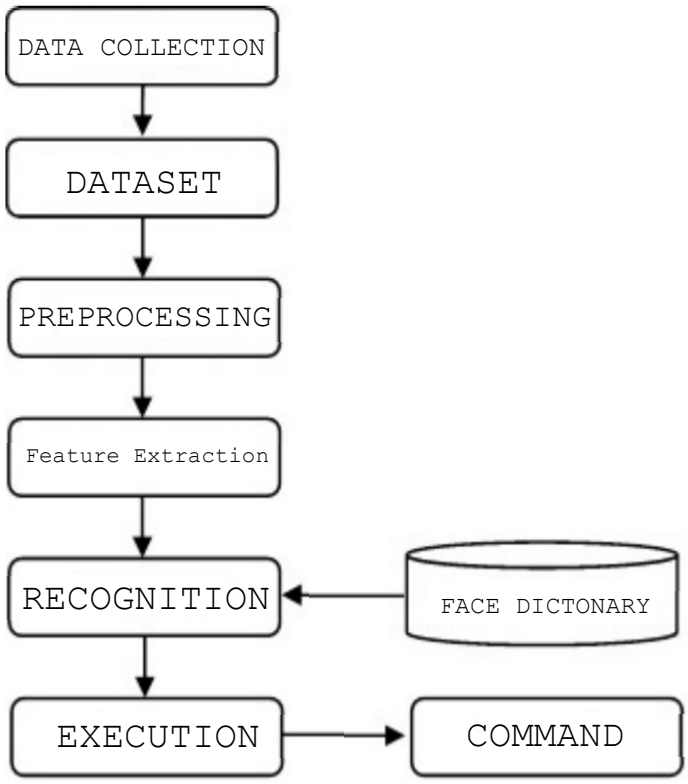
PROJECT REQUIREMENTS

- Hardware
  - Minimum 2.20 GHz processor Computer System
  - Graphic Card (GTX 16 series or RTX 20 series or comparative)
  - Webcam (HD capture 60fps or more)
- Software
  - Windows 10 or higher
  - Python 3.6 or higher
  - CUDA toolkit
  - DirectX 9.0 or higher
  - OpenCV
  - Tensorflow-gpu

IMPLEMENTATION

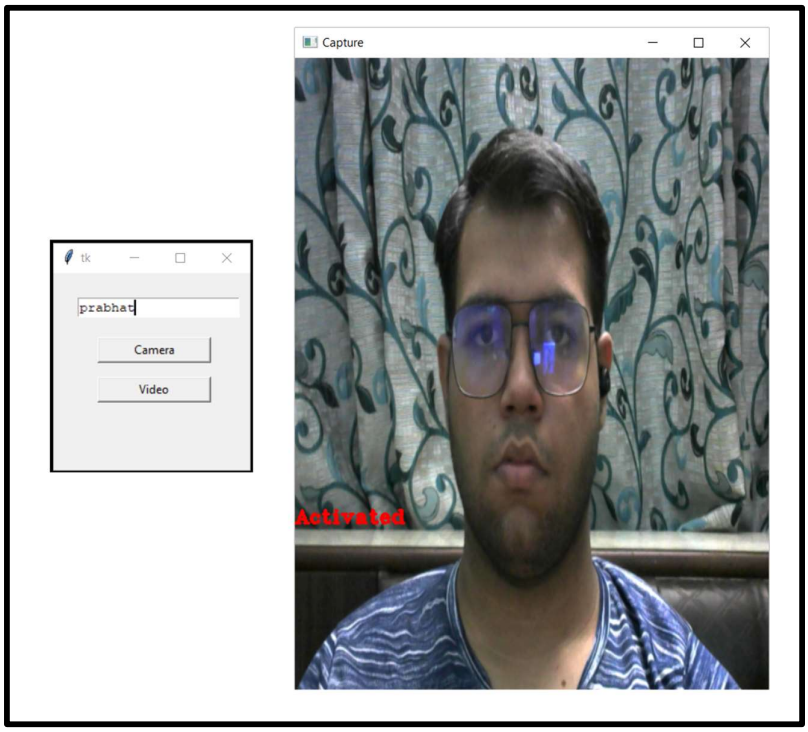
Face recognition system can be divided into following **four** modules:

- Data Collection
- Preprocessing
- Feature extraction of the processed image
- Real time classification



DATA COLLECTION

The project started with the treasure hunt of the dataset that could fit the objectives laid down, but it ends nowhere as the available datasets were of no use because they did not fit the requirements. Hence it the hunt led to manual collection of face images sample from colleagues. A GUI was developed that instructed the user through steps and collected their faces according to the needs and then the folder created was zipped and send to us.



DATA – PREPROCESSING

Pre-processing is necessary for enhancing robustness, faster training, and recognition accuracy. The preprocessing prepares the image sequence for the recognition, so before sending the image to CNN a pre-processing step is performed to get the appropriate image, which is required for real time classification. The net effect of this processing is to extract the face only from the given input because once the face is extracted from the given input it can be recognized easily. So preprocessing step consists of following tasks:

- Detection of face in image
- Extraction of face
- Resizing to required size

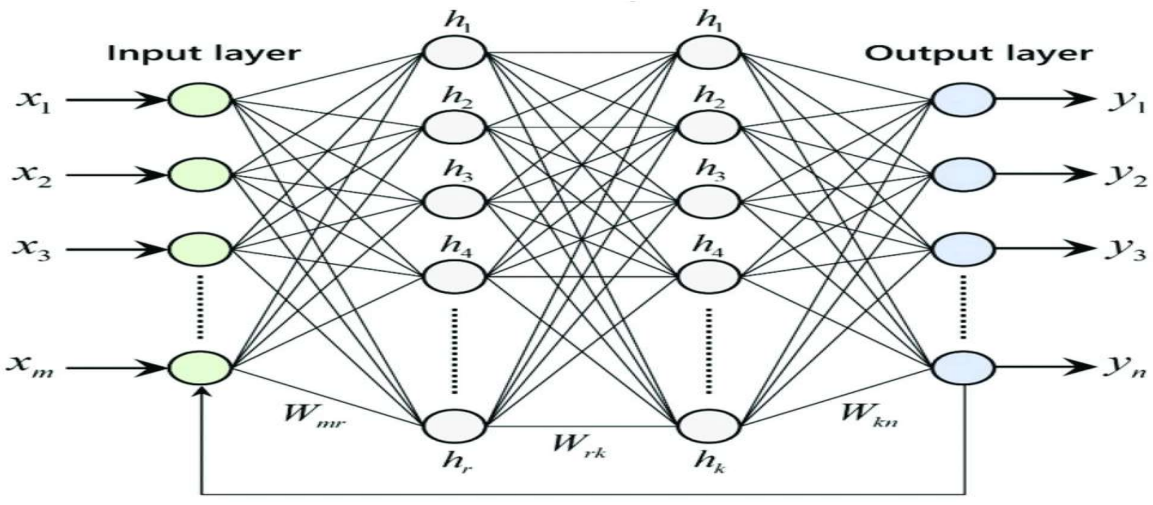
FEATURE EXTRACTION OF PROCESSED IMAGE

The processed image is now sent to model for the extraction of the feature and prediction of its respective class. This was done using CNN which had **9 Hidden Layers** which were further connected to an ANN thus completing the whole structure of the neural network

- ## NEURAL NETWORK

  Neural networks are composed of simple elements operating in parallel. They are inspired by the working of an actual brain in natural environment. As in nature, the network function is determined by the connections between elements. Neural networks are a powerful tool for machine learning and training them can be a challenging task. There are a few things to keep in mind when training a neural network, such as the type of data you are using, the size of the network, and the number of training iterations. With the right data and parameters, neural networks can be trained to be exactly accurate at predictions.

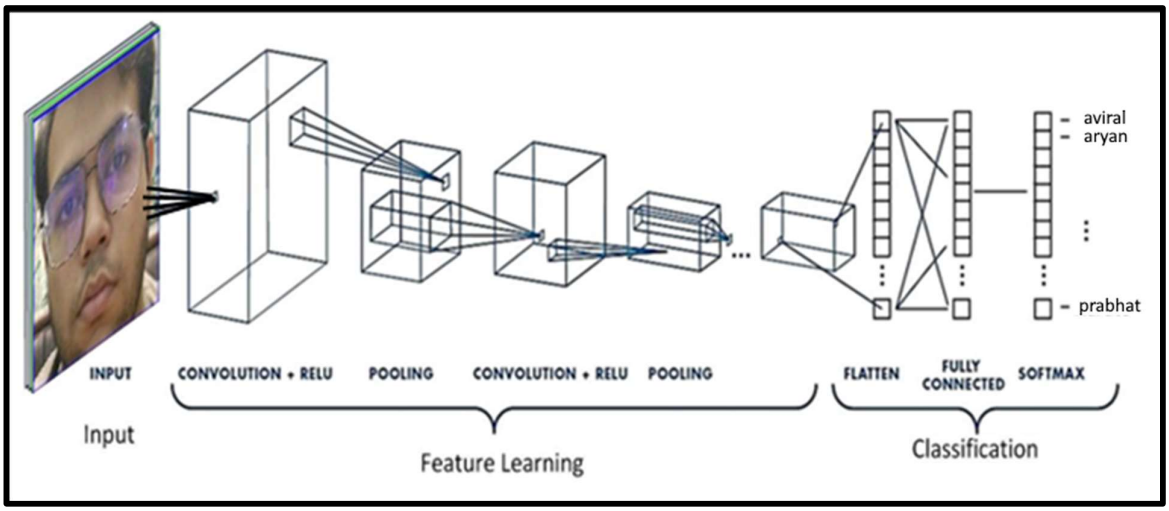
  Neural networks are trained such that each input communicates and leads to a specific target output. Such a situation is shown in Figure 4.1 below. There is reiteration over the data and the weights are adjusted by backtracking. An extensive dataset is required to train a neural network to predict accurately.



- **CONVOLUTIONAL NEURAL NETWORK**

Convolutional Neural Network (CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. CNN does not require much pre-processing as the neural network is itself capable of extracting features. While in primitive methods filters are hand-engineered, with enough training, CNNs can learn these filters/characteristics.

The architecture of a CNN is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex. Each neuron responds to reflex only in a restricted region of the visual field known as the Receptive Field. These receptor fields are all over the image and communicate to predict result.



REAL TIME CLASSIFICATION

The next and the ultimate step was to create an interface that would be easier for an average person to use. Hence a web app was created using flask and html. To use the face detection system, interface the user first must activate a server and then go to the web page. In the web page the camera will be used for capturing the live video and predicting person.

RESULT AND ANALYSIS

Evaluation of time in an image processing and recognition procedure is particularly important for result and performance, which shows tendency in all techniques which are used to recognized faces. There are few factors that prejudiced on the results such as quality of image, size of image (e.g., **100x100**) and the parameters of recognition techniques or algorithm. In CNN, neural network used for training and testing and there is real time classification training and testing, so it takes more time. Therefore, time counted for training phase. Given image to system for evaluating it include training, testing, feature extraction and recognition of that image following is processing time for training process:

Process Clock Speed: Intel i7 2.20 GHz

Image Size: 100 px X 100 px

Batch Size: 10

Average time of 1 Epochs: 45 sec

Total time for complete Training: 1.2 min

The accuracy stats of the model after running 2 epochs comes out to be **96.6%** which means that model gives quite correct prediction in real time. The epochs' stats are as follows:

```
Epoch 1/2
893/893 [==============================] - 55s 61ms/step - loss: 0.8992 - accuracy: 0.6953 - val_loss: 0.3120 - val_accuracy:
0.9010
Epoch 2/2
893/893 [==============================] - 25s 28ms/step - loss: 0.2159 - accuracy: 0.9378 - val_loss: 0.1122 - val_accuracy:
0.9731
```

REFERENCES

- **Edureka Deep Learning**
  https://www.youtube.com/watch?v=DooxDIRAkPA

- **CUDA setup**
  https://www.youtube.com/watch?v=StH5YNrY0mE

- **Simplilearn Convolutional Neural Network Tutorial**
  https://www.youtube.com/watch?v=Jy9-aGMB_TE

- **Baby Steps to learn CNN**
  https://www.youtube.com/watch?v=jZVVFUhsbgY

- **Comprehensive Guide to CNN**
  https://towardsdatascience.com/a-comprehensive-guide-to-convolutional-neural-networks-the-eli5-way-3bd2b1164a53

- **Learning FLASK**
  https://www.youtube.com/watch?v=oA8brF3w5XQ

- **Deep Learning Course**
  https://www.udemy.com/course/deeplearning/

- **Learn Tensorflow**
  https://www.youtube.com/watch?v=tPYj3fFJGjk

- **OpenCV Documentation**
  https://vovkos.github.io/doxyrest-showcase/opencv/sphinx_rtd_theme/index.html