

FACE DETECTION AND RECOGNITION

ABSTRACT

Today even in the presence of high-tech security services data breaching and misuse is a major issue to worry on. People are never sure whether their data is secured or no. Also, with the constant increase in the crime rate all over the world there is a need to upgrade our security standards. Here, we propose a new system for such purposes. A face detection and recognition system.

Face detection is a system that detects and identifies the presence of human face in each image or video. Whereas, face recognition is one step further, it tries to identify whose face is it by comparing it from its database. Face detection and recognition using Machine Learning has proved to be a key aspect in various fields. It acts as a human brain, helps to recognize faces and distinguish it from rest of the objects.

Facebook's auto tagging system is one of the most recent application of face recognition. As soon as you upload a photo it will tag the person automatically. In this thesis, we will discuss face detection and recognition based on deep learning techniques. We have used OpenCV library along with cascade classification for the detecting face, SQLite Studio to store criminal records and for recognition we have used machine learning techniques. Our primary focus in this project is to detect and recognize faces of the criminals from real-time images and videos.

Chapter 1

Introduction

1.1 INTRODUCTION

Today the most important part in any industry is its security and authentication of person. Data accessed by an unknown or non-reliable person may lead to a big loss for the company. Various techniques have been implemented for this purpose but one of the most recent and effective technique is face recognition. It is the most reliable technique to authenticate a person's identity. Not only in industries but it can also be used for crime detection.

Face Detection and Recognition has gained significant importance in recent few years. We can find this application from our mobile phones to high level security services. Face detection and Recognition has become a very integral part of our life. Now, it has also been included in various government documents to avoid any fraud or mal practice.

It is considered to be one of the most important and secured application in providing security. Passwords and Pins can nowadays be easily cracked as a result there was a need to upgrade the security providing services. Thus, face detection and recognition has proved to be a revolutionary measure in this field. With face detection and recognition we can provide or deny access to a person based on the history or details what we have stored in our database.

Here, we are considering face detection and recognition application to identify criminals and to gain their criminal records from our database. This application will definitely help and prove to be a crossing milestone in field of providing security. This application will identify and store various features of human face. This data is then trained and used to recognise the face when required. Here along with the face and its dimensions, we can also identify eyes, mouth etc. and based on the results data gathered we can conduct the detection and recognition procedure.

In this research work, I'm trying to propose a system that will detect and recognise face of a person and matching it with its database it will provide information. This system is proposed to improve methods of Crime Branch of India to detect criminals. When a person is seated in front of the camera, his face will be detected and recognised. This detail is then matched with our database. If the person's face is matched with our database, then all the details will be display on the screen. These details include Name, Age, Gender, and Criminal Records.

Here, the database software used is SQLite Studio. Other than this, various python libraries will be used. The face Detection will be done with the help of OpenCV. OpenCV is one of the most popular libraries in python, used to identify face within a picture.

As face patterns are very complicated it is not easy to detect faces with normal libraries. The algorithms break the work of recognizing the face into a many small tasks, equal to a size of byte, and becomes easy to solve.

Deep Learning is a part of ML technique that can teaches a machine to learn by themselves just like humans. There are lot of applications of deep learning around us like object detection, pattern recognition, speech recognition, sentimental analysis, disease detection etc.

We create a deep learning model to learn how to perform the task and they learn and produce great results when they are tested in terms of accuracy and precision. These models are trained with a large amount of data and they can even exceed human level performance as well. As we have a lot of labelled data available with us it's easy to train a model on that and then they can produce results which are comparable to humans that too in small amount of time.

Face Recognition models are derived from the base class of FaceRecognizer, which gives unified access to all face recognition algorithms in OpenCV.

1.1.1 Face Recognizer class supports following features:

1. Training
2. Prediction
3. Loading/Saving
4. Setting/Getting Labels Information

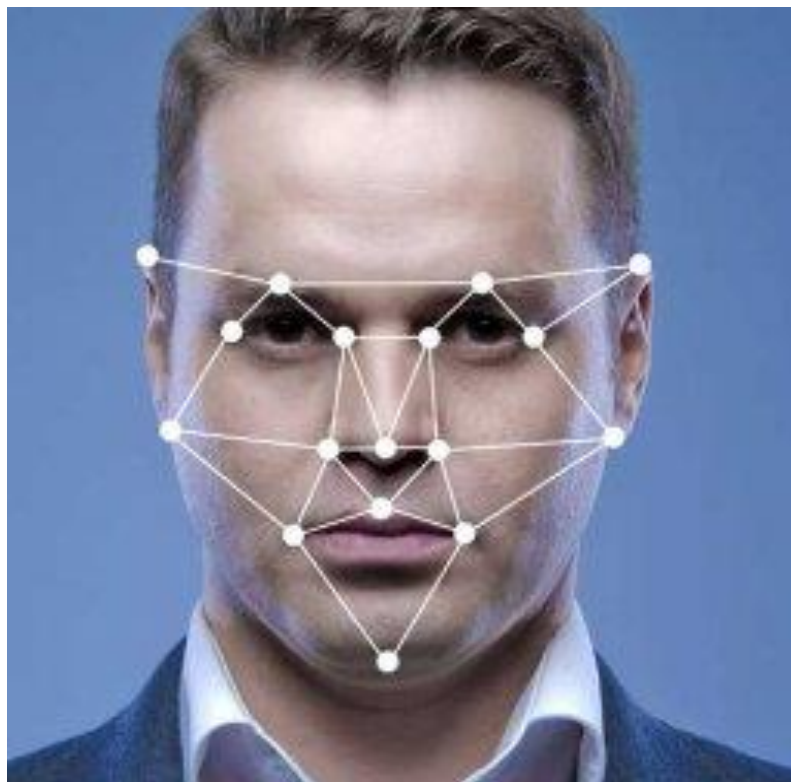


Fig. 1.1 Face Coordinates used for Recognition.

Source: <https://www.baseapp.com/deepsight/realtime-face-detection-analysis-surveillance-videos-2018/>

Above we can see how we how face detection works. Various points on human face are identified and spotted. These point are then stored along with the face details in the database. When we want to recognise a face these points are then referred and matched from our database. If similar details exists in our database then the face is recognised successfully.

We live in a world where everything has been digitalised. Earlier we used to store data by writing down notes or maintaining books, directories. But now in the modern era, we don't have to keep any such materialistic notes. Everything is stored on the computer.

But when we have this vast pool of data, we have to use this data in a better way. If this huge data is not used properly then there is no use of storing such data. We can use this data to make various predictions, analysis etc.

Today, all types of data is easily available on the internet. One can easily access this data and perform various operations. In this era, data is considered the most important aspect in any company. Many e-commerce or IT companies pay millions of dollars just to obtain data. This data is then classified and analysed based on this various predictions are made for the growth of the company. These companies monitor their user's behaviour and take required actions.

Getting the insights of the data is very important, especially when you are working for a consumer based company. This makes decision making easy for the company based on the records and output they obtain from the data. Without data or proper records, a company cannot take its important decisions. Even if the take some decision it is possible that they might fail to gain the expected target. As a result, decisions based on proper analysis are more likely to succeed.

Reaching to this conclusion, we can say that, data is the most important aspect for growth. This data can be classified using various methods or techniques which includes data mining, ML and DL etc.

Data Mining, ML and DL are internally connected to each other. If you analyse it, all the three techniques have the same goal, to extract insights of the data, identify different patterns, relationships which when combined together can be used to make various decisions. Artificial Intelligence is the latest inventions in the scope of data mining.



Fig. 1.2 Different parts of Data Mining

Source: <https://www.microjobcart.com/mjob-post/i-will-do-web-scraping-data-mininglead-generationdata-extraction/>

As you can see, in the above mentioned figure, data mining is divided into three different section.

- a. **Statistics:** Here, it is not necessary to have a huge amount of data. This technique generally work with the mathematical conclusion of the data. It will just show you the overview of the data. No insights of the dataset will be obtained.
- b. **Machine Learning:** In this technique, dataset can be analysed, processed and various operations can be performed on it. Many algorithm for prediction, classification etc. can be used to get a brief knowledge of the data and to gain required output.
- c. **Artificial Intelligence:** It is the most important outcome of data mining. Various algorithms are applied on the data to train the model and perform some required task. This provides very high accuracy.

1.2 Data Mining:

Data Mining is considered as suspect of different methods to extract insights from data. Including various statistical and machine learning methods, it applies various methods to identify patterns and relationships from the data. Data mining consists of statistical algorithms, machine learning, text analytics, time series etc. Data mining also contains data storage and manipulation. Today tons of data is easily available on the internet. This data is of no use until it is properly analysed or useful information is carried out from this data. Proper data should be extracted from this huge data.

Data Cleaning, Integration, Transformation, Evaluation and presentation are few other features of data mining. In other words data mining is said to mine knowledge from the data. Data Mining is widely used in market analysis, corporate and risk management and fraud detection. The general approach of data mining is as follows:

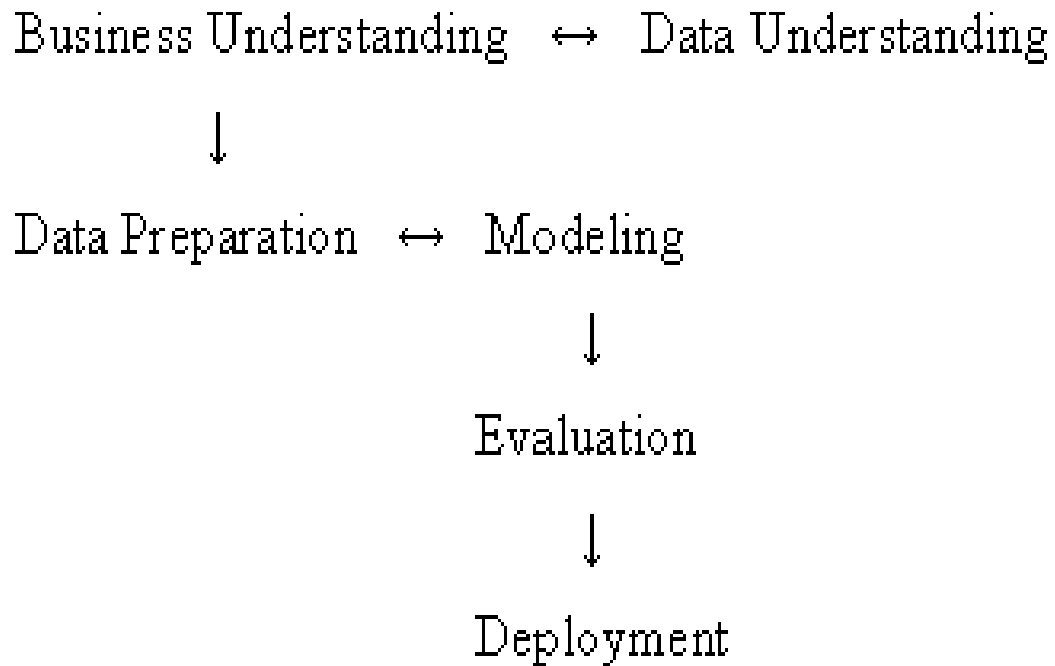


Fig. 1.3 Approach of Data Mining

Source:

<https://pdfs.semanticscholar.org/aebc/b8e10313b79de0b32bba0242dc83d6a015f7.pdf>

Above we can see the flowchart of data mining. Data Mining goes through various steps to generate an output. Initially Business understanding is necessary to identify what type of data is required for the business. For that you need a good knowledge of the business. Without a good understanding of the business one may make a mistake of selecting wrong data which will lead to unwanted or irrelevant data.

Once the business understanding is developed, now we can go for the data which we need. Getting the right data is very important for accurate results. If the data picked is irrelevant then even if the algorithm is right, we won't get appropriate results. Data preparation comes after this. Once the required data is extracted, all the impurities are removed from the data which include noise.

Modelling is the most crucial step in data mining. Here, we build a model which will learn from the data and make the required analysis or predictions. With the help of various data mining or machine learning technique this model is trained and learns from the data. As big the data is, it will give more accurate outcomes. Then comes the evaluation phase where we evaluate various conditions and organize the data

accordingly. Once the modelling and evaluation phase are done then the system or algorithm is ready to be deployed.

First step towards data mining is data gathering. Here, all the relevant data is gathered. This data can be transactional data which deals with day-to-day operations of the company, or non-operational data is used for various forecast, and third type is metadata which is logical database design. Patterns and relationships amongst the data is identified which helps to improve company's revenue. Especially for consumer based companies data mining is very beneficial to help them to analyse the products sold, price and other competitions.

Using suitable algorithm is the next and most important step in data mining. This helps us to build a model for analysis. The procedure involves identifying trends in dataset and with the output produce useful information. Regression algorithms are the most popular and widely used data mining algorithms. Regression algorithms is one of the most simple data mining technique as it is easy to implement. Also, it can be used over a wide range of fields for making data mining analysis.

1.2.1 Why is data mining important?

A data is of no use if meaningful information or knowledge is extracted from it. Data should be classified, analysed or prediction. Then only it can be said that a proper understanding or knowledge is obtained from the data. Here, use of data mining in growth of a company is considered as the most important aspects.

You've seen the staggering numbers – the volume of data produced is yearly is unstoppable. Out of this unstructured data is the highest making up to 90 percent of the digital universe. But more information does not necessarily always give more knowledge.

Data Mining helps you to:

- Avoid the chaotic and repetitive noise in data.
- Use only data which is relevant and gain knowledge out of it.
- Decision making becomes quick.

1.2.2 Steps of Data Mining

Data Mining can be further classified as five different steps.

1. Collecting data and loading them into data warehouse.
2. Storing and Managing data.
3. Business analysis, and various other methods are carried out on this data and determine how to organize the data.
4. Sorting the data based on the results.
5. Presenting the data in such a way that is easy to understand, e.g. Graph or table.

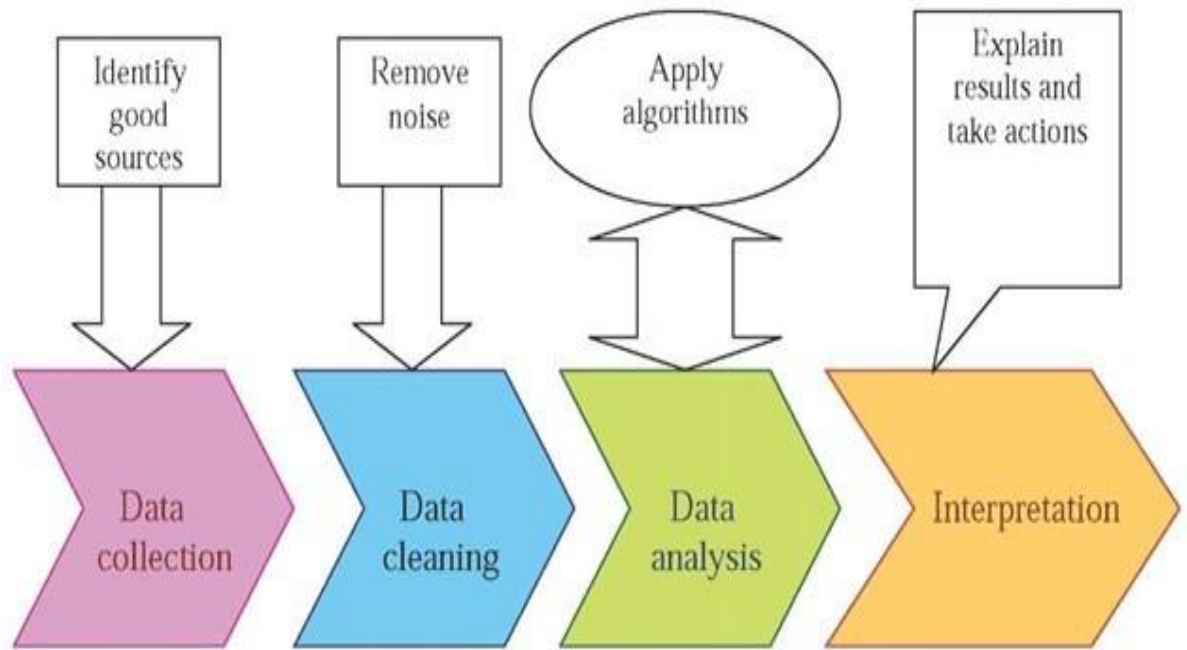


Fig. 1.4 Steps in Data Mining

Source: <https://blogsidth.000webhostapp.com/2017/11/introduction-to-data-mining>

Above we can see the data lifecycle in data mining. In the initial or first stage of data flow consists of data collection. First we collect all the data that we think is relevant to our area of research. All the things that we need to reach to a specific conclusion.

Then once the data is collected, it is necessary to remove all the irrelevant data or data that consists of impurities or noise. If this is not done that that may affect or final outcome or results.

Data analysis is the next and the most important part in the data lifecycle. Here, we perform various operations using different algorithms to obtain. This step includes data classification, analysis and prediction. Algorithms should be properly applied so as to get accurate outputs.

Once we get the output we must know how to interoperate the result. If no proper conclusion is drawn from the result then all the efforts are wasted.

1.3 Machine Learning:

The machine learning process is considered as a branch of data mining and is similar to data mining and predictive modelling. Both data mining and machine learning follow a primary procedure of searching through the data to look for patterns and adjusting the actions accordingly. Many of us have seen the use of machine learning from shopping e-commerce website on the internet and being looking at the ads related to their purchase. This is possible due to the recommendation systems which uses machine learning to personalize online advertisement served in real time. Also other than personalized marketing, machine learning is used in various other cases i.e. fraud and network security, etc.

Machine Learning basically helps the machine to gain from precedents and experience, without the need to be programmed. That means other than writing the entire code, we just must feed data to the respective algorithm, and the logic is built by the algorithm based on the data provided. Let us consider one real life example of machine learning.

Most of use ecommerce websites nowadays, while looking out for an item, you will notice that the website recommends for an item Have you seen “the person purchased this item also purchased this” combination of items. How do we get these recommendations? This is called (ML) Machine Learning.

Machine learning being a subset of artificial intelligence (AI) having an essential spotlight on machine learning picking up the experience and making precise predictions based on its experience gained from information given. It helps the PCs or the machines to make precise and accurate decisions dependent on the data, instead of coding it to do a specific task. Here, these algorithms or methods are coded so that they learn and will in general improve their accuracy after some time when the model is prepared with new information.

Today, we are living in the realm of people and machines. The Humans are gaining experience from their past encounters all through their lifetime. Also, the time of machines and robots are improving and developing over time. You can say that we are living in the crude time of machines, while the fate of machine is splendid and is past the extent of human creative ability. These machines or the robots are coded before they begin adhering to our directions.

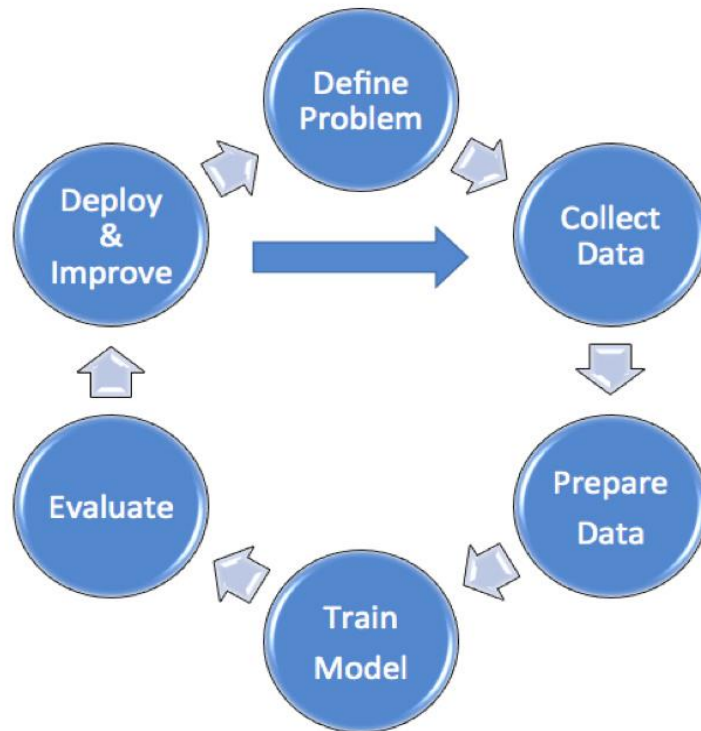


Fig. 1.5 Flowchart of Machine Learning

Source:

<http://www.bindt.org/admin/Downloads/Niels%20Jeppesen%20Presentation%20NDT%20Workshop%20Blyth.pdf>

1.3.1 Flowchart of Machine Learning.

1. Define the Problem:

In the above figure, we can see the life cycle of a machine learning system. A machine learning program is result of a problem. There won't be any machine learning program if we don't face any problem. Once we identify a problem then we try to tackle it with a machine learning program. So, defining problem is the first phase of machine learning.

2. Collect the data:

Collecting appropriate and relevant data is a crucial and important thing in data mining. The larger the data and variety of data, the more accurate the machine learning model perform. This includes spreadsheets, text files or databases etc.

3. Prepare the data:

This involves analysing, cleaning and understanding the data collected. Removing or correcting outliers, noise this usually takes around 70% of the overall time and effort of the overall phase. The data is then divided into two different parts, Training dataset and Test dataset.

4. Train the model: The training dataset is generally used to identify the patterns or relationships amongst the data or make predictions, while improving the accuracy using trial and error improvement method.

5. Evaluating the model: This is done by verifying the accuracy of the results against the set of test data. It's important not to evaluate the model against the data used to train the system to ensure an unbiased and independent test.

6. Deploy and Improve: Which can involve trying a completely different algorithm or gathering a greater variety or volume of data. You could, for example, improve house price prediction by estimating the value of subsequent home improvements using data provided by homeowners.

1.3.2 How Machine Learning Work?

Machine Learning algorithms are trained with the help of dataset kept for training to generate a model. As we train the ML model with the latest dataset, it is trained and gives prediction based on the prototype prepared. In here, results or predictions are verified based on the accuracy, if the accuracy shows good result, the ML model is accepted. If the accuracy is not good, the Machine Learning algorithm is trained multiple times using new training data.

You have of course received many calls from various banks or finance companies offering you loans or other insurance policies? What do you say, how do they get to you? They make a call to some specific clients who they assume may buy the items or policies. This is machine learning technique that perhaps deployed with the help of clustering. It is called target marketing.

ML works on feature extraction and analysis principle, where features are to be extracted manually and then are processed based on how the algorithm applied works.

1.3.3 Types of Machine Learning

1. Supervised:

It is a technique, where you can say that the learning is guided by a human. Our dataset acts as a guide and trains the algorithm. As soon as the prototype has completed learning it will start executing predictions or decisions when latest data is given.

2. Unsupervised :

Here, our model will learn by its own via a series of observations and identifies patterns in the data. As soon as the method is provided with data, it has the ability to identify patterns as well as relationships automatically in the dataset by generating clusters in it. The drawback is that it cannot include labels to the cluster, as it does not recognize the group of oranges or pears, but it will separate all the oranges from pears

3. Reinforcement :

Operator connects with environment and discover the most exact result. This works on the ideology of hit and trial system. The operator is remunerated or punished with a point for a right or a wrong answer separately and dependent on the positive reward focuses picked up the model trains itself. As soon as it is prepared it prepares to foresee the new information displayed to it.

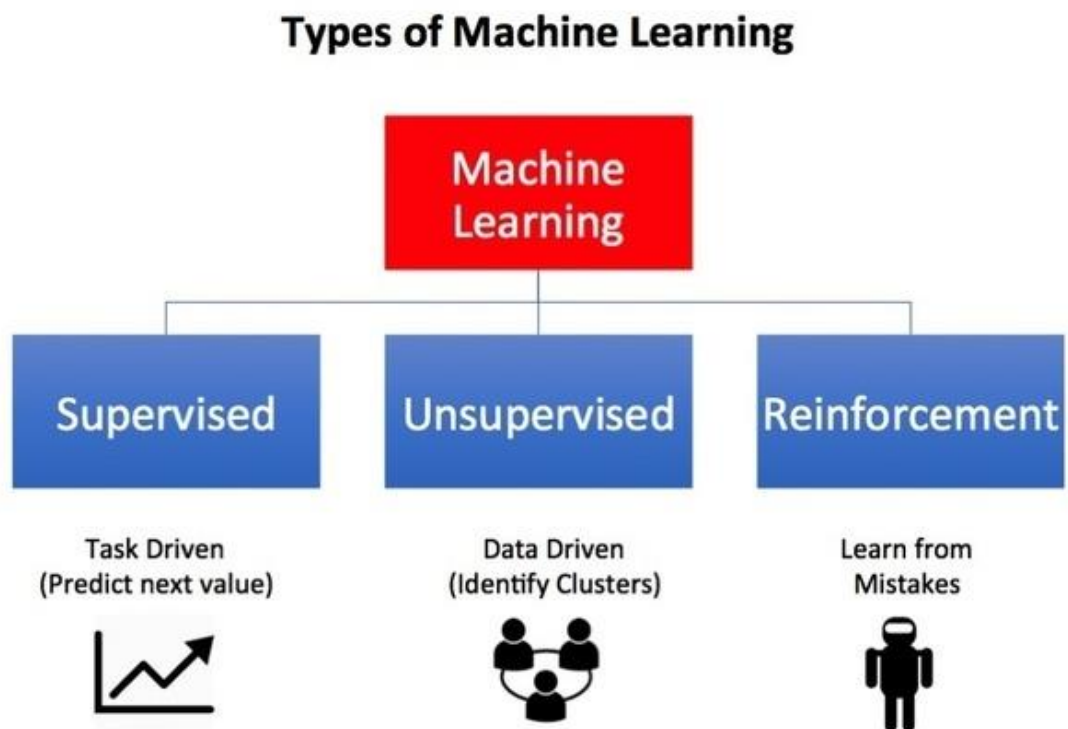


Fig. 1.6 Types of Machine Learning (ML)

Source: <https://medium.com/deep-math-machine-learning-ai/different-types-of-machine-learning-and-their-types-34760b9128a2>

1.4 Deep Learning

We know that, Deep learning is an essential part of machine learning that makes a computer learn various things or actions which are naturally performed by humans. New inventions such as automatic or driverless car, which helps a machine or car to identify and recognise stop or go sign on the signal. Identify the object in front of it, it can be another car, a person etc. It is also used for voice control in various devices such as phones, hands-free, TVs etc. Deep learning is one of the most recent outcome of machine learning and has gained importance in recent years.

Deep learning helps machine or device to perform various tasks such as classification etc. from the input given, this can either be an image, sound or textual data. A very high accuracy rate can be expected if proper data and algorithm is used. Deep learning models are trained before they are practically used on a dataset. This algorithms can be trained by labelled data and neural network architecture that consists of various layers.

1.4.1 Why Deep Learning

Deep learning helps us to gain very high accuracy. This advantage of deep learning to give high accuracy satisfies user's expectations. It is also proved to be necessary to provide high accuracy for safety. E.g. in driverless cars etc. Recent research have shown that sometimes the accuracy of deep learning is so high that it outperforms human abilities.

Deep learning was first quoted in the year 1980, but has gained importance recently due to:

1. A huge amount of labelled data is required for deep learning to work. To provide such high accuracy is not possible with small data or limited dataset. One need a huge dataset for getting good accuracy.
2. Also for deep learning to work you need a good powerful computer. The deep learning algorithm consume so much CPU and GPU power that earlier it was not possible for the computer to provide such high power. High performance GPUs consists of parallel architecture which supports deep learning.

1.4.2 Application of deep learning in today's world are limitless.

1. Aerospace/Defence: Deep learning helps us to identify objects from a large distance as well. With the help of satellite this is possible. This can prove a revolution in defence strategies.
2. Auto Driving Cars: With the help of deep learning now we can also see the demand for driverless or automated vehicles. The vehicle can automatically identify objects or signs in front of them and perform the action accordingly.
3. Medical Research: High accuracy of deep learning has proved to be beneficial in medical work as well. Giving a good image classification results it can be used for detecting cancer cells.
4. Industries: Safety is the number one priority. This principle helps deep learning to identify and object or person within the danger range.

1.4.3 How Deep Learning Works?

Neural Network architecture is one of the most important method. It is also considered as base of deep learning. Most of the deep learning models are built on neural network. It can also be referred as deep neural networks.

In deep learning the word 'deep' points to number of hidden layers. And in neural networks there can be many hidden layers depending on the application. Traditionally only 2-3 hidden layers we there in neural network, but deep learning being an advanced version can have up to 150 hidden layers.

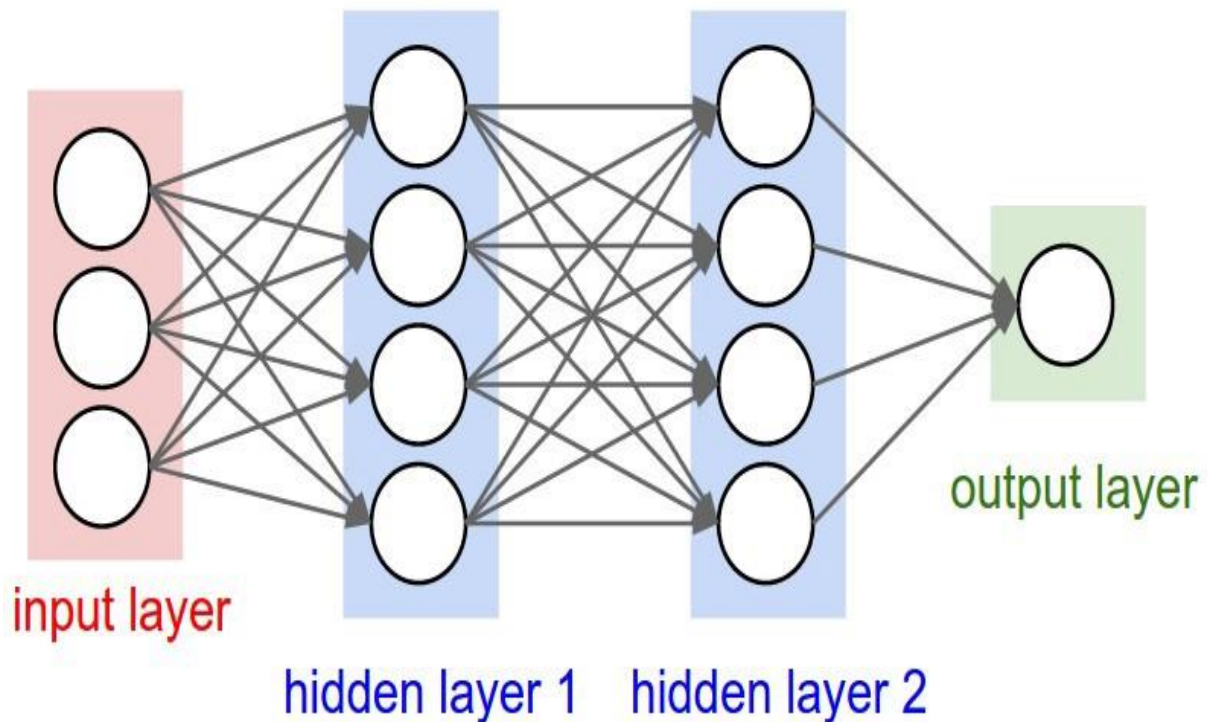


Fig. 1.7 Layers in Deep Learning

Source: <https://towardsdatascience.com/building-a-deep-learning-model-using-keras-1548ca149d37>

Convolutional Neural Network (CNN) is the most famous, used and simple deep learning neural network algorithm. The convolutional Neural Network learn by receiving input from the data. It uses 2D convolution layer. This CNN algorithm then makes it easy to process 2D data like images.

CNN not only just processes the data but also performs feature extraction. This avoids manual feature extraction and identify feature for image classification. The CNN extracts the features from the image, all the relevant features are learned and the network trains on the image collection. This feature extraction helps the deep learning to provide high accuracy. CNNs learns to detect features of an image by using various hidden layers. As the number of hidden layers increases then the complexity of image feature increases. The first hidden layer will learn to detect edges whereas the last hidden layer may also educate to catch more complex shapes.

1.4.4 Limitation in deep learning (DL):

Along with advantages, DL may also have various disadvantages or limitations. One such limitation is the deep learning works based on the observation. It needs previous data to be trained on, and it will only know what it has observed from the data. If the user has small area, then the data observation will be limited. Also the accuracy is compromised. Biases are also considered as one of the major problems in deep learning. It may also affect the prediction.

1.5 Difference between Machine Learning (ML) and Deep Learning (DL).

We can say that deep learning is an advanced form of ML. In ML we have to physically extract the related features from a picture or image. These features are then used to make the model learn and help to categorise the object in the image.

On the other hand, deep learning automatically extracts all the relevant features from an image. Once the data and the task is given, it will perform the required task automatically. Deep learning scales with data, whereas machine learning scales with shallow learning converges.

The main difference between them is that as the data increases the performance of deep learning also improves. In machine learning we have to manually choose the features and classify to sort images. Whereas, in deep learning this task is done automatically.

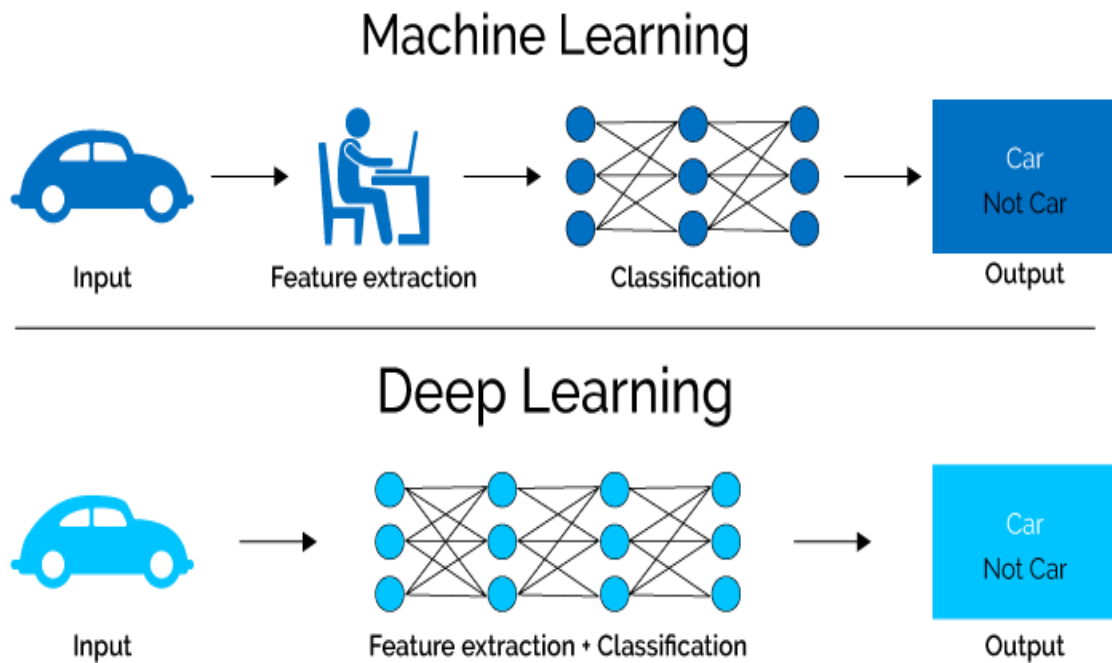


Fig. 1.8 Difference between Machine Learning and Deep Learning

Source: <https://medium.com/datadriveninvestor/ai-vs-machine-learning-vs-deep-learning-ba3b3c58c32>

1.6 OpenCV

OpenCV is a computer vision and ML library. This library was built to provide an infrastructure for computer vision and involves the use of machine learning for commercial products. OpenCV contains more than 2500 optimised algorithms, including both classical and machine learning algorithms. These algorithms are used to detect faces, objects identification, track human actions, movements of objects or humans, 3D image processing and etc. The library is widely used in various companies and research labs. It can work on C++, Python, Java and MATLAB and support Windows, Linux, Android and Mac. OpenCV is used mostly for real-time computer vision.

It is a library which is cross-platform and helps to develop computer vision applications. It helps in image processing, video capturing and analysis which includes face detection and recognition and object detection.

1.6.1 Computer Vision:

Computer Vision is defined as discipline that shows how to reconstruct, interrupt and understand 3D and 2D images. It basically replaces human vision with computer software and hardware.

1. Image Processing: It helps with image manipulation.
2. Pattern Recognition: It helps to classify patterns.
3. Photogrammetry: It helps to gain accurate data from the image.

Image processing works only with images. Both input and output are given and obtained in the form of images. Whereas, computer vision gives explicit and meaningful description of the objects from the image.

The support of Numpy makes working with OpenCV more interesting. Numpy is an optimized library used for carrying out numerical operations. OpenCV array structures that are generated are converted with the help of Numpy array. So, various operations can be carried out by combining OpenCV and Numpy, which gives you a very high accuracy algorithm.

Face Recognition models are derived from the base class of FaceRecognizer, which gives unified access to all face recognition algorithms in OpenCV.

1.6.2 OpenCV Features:

OpenCV can be used in multiple ways:

- 1** To read and write images.
- 2** To capture videos.
- 3** Video Analysis.
- 4** Processing Images.
- 5** Feature Detection.
- 6** Object or Face detection.

OpenCV was initially developed in C++ but now it also supports Python and Java. As mentioned earlier it is a cross platform library which also works on windows, Linux, OS etc.

1.7 Cascade Classification

Haar Cascade

A cascade classifier is trained with sample images of an object. This image can be a car for object detection or a face for face detection. Around hundreds of images per sample are taken to train the classifier. These images are called positive example. Negative images are the arbitrary images mostly of the same size.

Once a classifier is trained, we can use it on a region that we want in an input image. It will give an output as '1' if the object or face is found or else it will give '0' when no output is found. This can also be done to find an object or face in a particular image. This is done by moving the classifier throughout the image so that it can detect or find the required details. Here, the classifier auto-resizes itself when it finds an image of interest. It is better than rather resizing the image. To get an object or face in an image of varying size the classifier scans the image several times and detects the object or image.

"Cascade" in the classifier name implies that the resultant classifier comprises of a few less complex classifiers that are connected therefore to an area of interest until at some stage the candidate is rejected or every one of the stages are passed.

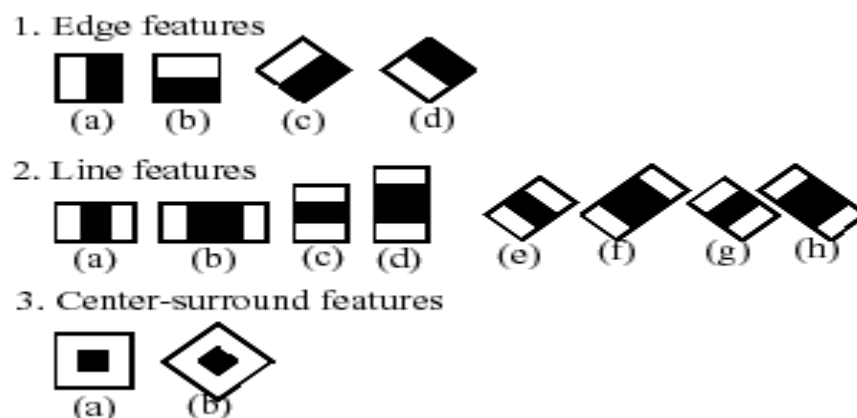


Fig. 1.9 Haar Cascade

Source: <https://towardsdatascience.com/whats-the-difference-between-haar-feature-classifiers-and-convolutional-neural-networks-ce682834aeb>

The component utilized in a specific classifier is determined by its shape (1a, 2b etc.), position inside region of interest and the scale. For instance, on account of the third line highlight (2c) the reaction is determined as the contrast between the entirety of picture pixels under the square shape covering the entire component and the whole of the picture pixels under the dark stripe duplicated by 3 so as to make up for the distinctions in the measure of zones. The wholes of pixel esteems over a rectangular areas are determined quickly utilizing vital pictures

1.8 PROBLEM STATEMENT

Nowadays, the crime rate all over the world is increasing drastically. Not only the crime but also the technique used by the criminals or the way they commit crimes have also changed and are more effective. As there is a desperate for the security forces to upgrade their technology in order to catch the criminals and prevent crimes. The existing system does not have any method which will help the security forces to catch the criminals. They have to manually investigate or go through various places in search of the criminal. This can be a time consuming and not prove to the most effective way for countering the criminals.

Here, we are proposing an advanced and most effective approach to tackle these issues.

1.9 SCOPE OF THE PROJECT

Crime rates and techniques in past few years have drastically increased. It has become very difficult for our security forces to catch these criminals as they have become smart and always find new ways for committing a crime. Along with them our security force should also improve.

With the availability of new technologies it is now high time that we introduce them in our security services as well. Face detection has gained importance in recent years. Right from providing security features in mobile phones to recognizing people for various purposes. A face detection and recognition can prove to be a revolutionary step

in stopping crime to a large extent. Installing security cameras in places where the crime rate is high can help us to detect frequent movements of the criminals and will help us to catch them.

Our project also strive to provide one such feature. Here we are trying to implement face detection and recognition for criminals. As criminal activities have increased drastically it is humanly not possible to keep a manual note of a person and his details. So, in this situation we take help of machine learning.

The main aim of our project is to identify human face and recognize them using machine learning algorithms and python libraries. This project basically keep track of criminal record and other details of a person. When a person is brought in front of our camera, his/her face is detected. Using OpenCV and other libraries his/her face is matched with the details stored in our database. This details is then displayed along with his/her criminal details which is stored in the database.

Here in this paper, we try to extend or improve our storage capacity by introducing SQLite. Rather than providing the data within the python program which is not an ethical approach, we will be using SQLite database which will help us to store data and other details in the database which will help is to store more data.

1.9.1 Our project mainly focuses on these things:

- 1** Understand the dataset, process the image and extract required details.
- 2** Making face detection and recognition useful for various security purpose.
- 3** Connecting and storing the images obtained in the SQLite database.
- 4** Using SQLite help us to store large amount of data and other details of the criminal.
- 5** To provide high accuracy in human face detection so as to identify the criminal which will enhance our security system.
- 6** Training the data with more images to increase the accuracy.

1.10 OVERVIEW OF THE PROJECT

Identify criminals is one of the most difficult task in our security system. Along with years passing the criminal activities have increased and the techniques or ways used to carry out these activities have also become unique and smart. As a result to counter these activities the security measure should also improve. Here we have proposed a face detection and recognition technique. This technique will help us to identify the criminals and find out their criminal record using machine learning. This makes our security measure more agile and reliable. Rather than storing or keeping track of the records manually this method will help us to simplify the process. We have used OpenCV libraries to detect and recognize these criminals which are stored in our database. So, when a criminal is brought in front of this camera we model will detect and recognize his/her face and extract his/her details from our database and display it on to the screen.

Chapter 2

Literature Survey

2.1 EXISTING WORK

Face detection and recognition has gained popularity in recent years. But still the methods used are slow and not reliable enough.

In various techniques the data is given in the code file itself. Which is not one of the most appropriate method. Considering criminal face detection and recognition system, it has not yet been fully implemented in India, due to its lack of accuracy and reliability.

- 1** Face recognition biometrics is the way of coding a machine to identify or recognize a human face. When a person is enrolled in a face recognition system, a video camera takes a series of snapshots of the face and then represents it by a unique holistic code.
- 2** When a person gets his/her face authorised by the computer, the system takes a snapshot their present look and matches or compares it with the facial data earlier stored in the system.
- 3** The person is authorised by matching his face. The current facial data recognition system verifies only static face images.
- 4** At point when the present picture caught precisely coordinates with one of the pictures put away then the individual is recognized and allowed get to.
- 5** When the present picture of an individual is significantly extraordinary, state, regarding outward appearance from the pictures of that individual which are as of now put away in the database the framework does not perceive the individual and consequently access will be denied

2.2 EXISTING TECHNIQUES/ALGORITHMS

The existing face detection and recognition system uses LBP cascade. Accepting that the technique used is a bit faster than our proposed technique, but the accuracy of our technique is three times better than the current technique. LBP cascade uses integer precision whereas our proposed haar cascade uses floating point precision. If we consider the data storing technique, the data has to be manually give in the code.

The existing techniques are as follows:

- Principal Component Analysis (PCA) Face Detection
- Viola-Jones Face Detection
- Eigenfaces
- CNN

2.3 DRAWBACKS OF EXISTING WORK

The LBP cascade classifier used has a very low accuracy rate. Even though the technique used is a bit faster than our technique, but for such crucial cases like criminal face detection it's better to use a bit slower technique and get good accuracy rather than using a faster technique and not getting a good accuracy. Also the data storing technique is not good enough. Giving data during run time does not make it a good technique. A stable database should be there to store data.

- The current or customary face acknowledgment framework has a few impediments which can be overwhelmed by receiving new techniques for face acknowledgment
- The current framework can't endure varieties in the new face picture. It needs the new picture to actually coordinating a pictures from the database that may generally lead to wilfully ignorant of entry for the person.
- Here, execution accuracy in current framework isn't good.

2.4 LITERATURE SURVEY

2.4.1 LITERATURE SURVEY TABLE

Sr.NO	Name	Author and Year	Description	Technique	Pros	Cons
1.	Face Detection and Recognition in Videos	S.V Tathe, A.S Naote, S.P Narote. 2016	Distinguishing and recognizing the individual coming in the perspective on camera. Measures are undertaken to reduce the time of processing for detection and recognition purpose. [1]	Haar features and recognition utilizing Eigen and Gabor filtration in videos.	It will compare large number of features. It provides security at various places and avoid access of unauthorised people in such areas. [1]	Processing time to identify and recognizing the person is high. [1]
2.	Face Detection and Recognition using Raspberry Pi	Ishita Gupta, Varsha Patil, Chaitali Kadam, Shreya Dumbre 2016	Raspberry Pi based face recognition framework utilizing conventional face detection and recognition systems. Live application, that analyses the outputs to records put away in the Raspberry Pi. [2]	Haar detection and PCA (Principal Component Analysis).	Principal Component Analysis reduces the size of the database to which required to recognise the test image. [2]	Using Raspberry Pi and other hardware requirement may be not cost effective. [2]
3.	Parking Access System Based on Face Recognition	Imene TALEB, Madani Mamma r. 2015	An entrance control vehicle framework in parking lot are dependent on camera introduced at the parking entry. Non adaptive strategy to distinguish the moving things is utilized, and propose a prototype to identify and perceive the face of the driver who needs to enter to the parking area and confirm in the event that he is permitted. [3]	Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA)	This will simplify the parking system at various places and makes it easy. It will also avoid unauthorised cars to enter the parking area. [3]	The change in pose is considered as a big issue for the facial recognition model, this is one of the major drawbacks. [3]
4.	BENCHMARK FACED DETECTION	Gee-Sern Hsu, Thu Ha Tran,	The proposed framework will help us to generate test samples similar to those accessible from	Intrinsic Parameterization (IP), and the	As compared to all the previously published databases for	A lot of data is generated in the form of mother and daughter

	NGAFA CEREC OGNITI ON DAT ABASE	Sheng- Lun Chung 2010	a previous face detection datasets, and also samples unavailable from current face datasets. [4]	Extrinsic Parameterization and Spatial Distribution (EPSD).	benchmarking face detection, the developed system takes advantage of face recognition benchmark datasets and generates database which fulfils the objectives of different test criteria. [4]	dataset, which will lead to increase in compilation time. Certain parts our eyes detection ability reduces and the detection rate deteriorates. [4]
5.	Rapid Face Detection and Annotation with Loosely Face Geometry	Dr. P.Shan mugavadi, Ashish Kumar. 2016	Present a rapid partially occluded face detection (POFD) dependent on feature based technique mixed with part-based technique. First skin area is recognized, and afterward neighbourhood facial features are looked in skin locale trying to locate the most likely face part candidates. [5]	Partially Occluded Face Detection (POFD)	Partially occluded face can be detected and annotated with fewer facial components in real time scenarios by the means of loosely face geometry-based face part detection techniques. [5]	It is a very slow and time consuming algorithm as it detects and tries to identify each and every component of the face including the skin colour. [5]
6.	Face detection and recognition application for Android	Monica Chillaron, Larisa Dunai, Guillermo Peris Fajarnes, Ismael Lengua Lengua 2015	The present work is centered around creating face identification and face recognition software to be utilized by individuals who are blind. Development of a face identification and recognition framework for visually challenged individuals in real time by utilizing Raspberry Pi and Android application. [6]	Raspberry Pi and Android Application	This method proves to be very helpful for blind people and gives accuracy of 84.4%. [6]	Developing android application and Raspberry Pi may not prove one the most cost-effective solution. [6]

7.	Face Detection and Recognition Methods Based on Skin Colour and Depth Information	Jun Feng Qian'Shiwei Ma'Zhonghua Hao'Yujie Shen 2011	A very much improved technique that utilizes the skin shading data and depth of human face for identification and PCA algorithm for recognition. [7]	PCA (principal components analysis)	The main upper hand of this system developed is improved colour density detecting. Using this, the real faces with skin colour details and the drawing faces without skin colour details can be distinguished. [7]	The recognition accuracy may be affected by light, expressions and machine vibrations in some cases. [7]
8.	Design of Face Detection and Recognition System for Smart Home Security Application	Dwi Ana Ratna Wati, Dika Abadian to 2017	We can develop Home security system by utilizing face recognition method. Our face will be utilized as a key to get to home. By utilizing genuine face, the way toward opening the entryway will be increasingly successful and effective in light of the fact that it simply needs to coordinate a face on the camera, so the camera can recognize whether the individual is took into consideration coming in or not. [8]	MyRIO 1900 and programmed using LabVIEW	Provides high level security. System has 80% of accuracy [8]	There are various limitations such as the distance, colour of the shirts should not be same to skin colour etc. [8]
9.	Face Recognition: A Holistic Approach Review	Ghazi Mohamed Zafarudin, Dr. H. S. Fadewar 2014	In this approach face recognition is done dependent on global features from faces. All-encompassing methodology features speak to ideal differences of pixel information in facial pictures used to remarkably distinguish an individual. [9]	PCA (Principal Component Analysis), Artificial Neural Networks (ANN), Fuzzy Pattern Matching.	Compares various approaches to face recognition system and gives you the most appropriate method. [9]	Holistic based method to face detection using global information of faces, disadvantage is the variances captured may not be relevant [9]

10	An Approach to Face Detection and Recognition	Divya Meena, Ravi Sharan 2016	Shows a face detection procedure, in which human face is identified from a solitary picture and various human faces can likewise be distinguished from a solitary picture. A face detector needs to tell whether there is any face in that picture or not [10]	Viola Jones algorithm and Principle component analysis.	The accuracy is 90% and results are generated fast. [11]	High computation time, Viola & Jones ideology is fast technique, but it has some false values as well.[11]
11	An advancement towards efficient Face Recognition using Live video feed	Dhamija, J., Choudhury, T., Kumar, P., & Rathore, Y. S. (2017, October)	Face recognition has gained significant importance in today's world. Mobile phones, security services. A system provides live facial recognition. Our aim here is to focus on ways so as to consider how we can make an efficient surveillance and security assurance. [11]	PCA, fisherface and SVD	The system provides a very high rate of accuracy. [11]	As it uses a combination of three big algorithms the computation time increases. [11]
12	FACE DETECTION AND RECOGNITION FOR HOME SERVICE ROBOTS WITH END-TO-END DEEP NEURAL NETWORKS	Jiang, W., & Wang, W. (2017, March)	The main aim of this paper is to propose an effective face detection and recognition system which is based on convolutional neural networks for home service robots. The experiment is mainly conducted on WIDER and LFW benchmarks. [12]	Neural Network	Good accuracy and can be used in our daily life. [12]	Complexity increases with the use of neural networks. [12]
13	Real Time Recognition	Sameem, M. S. I.,	This paper proposes a simple and effective face recognition	Viola Jones	These stored images are cropped in	It is a very complex

	tion of Human Faces	Qasim, T., & Bakhat, K. (2016, December)	technique. Here the algorithm used is viola jones algorithm. SURF features are extracted from the stored images. [13]		order to make computation speed faster. [13]	algorithm. [13]
14	An Efficient Method to Face and Emotion Detection	Reney, D., & Tripathi, N. (2015, April)	Here, we are going to create a face and emotion feature database, this database is then used to recognise faces and identify emotions. We have used Viola-Jones algorithm to detect faces, whereas for emotion detection we will be using KNN classifier. [14]	Viola Jones and KNN	We have obtained an accuracy up to 95%. [14]	It is a very complex algorithm and KNN increases computation time. [14]
15	Face recognition and detection using neural networks	Bhandi wad, V., & Tekwan i, B. (2017, May)	In current paper we will be performing face verification and recognition task. The face verification will detect and recognise the face from the database and provide access. The training data consists of 188 facial images. [15]	Neural Network	Neural network used here gives a good amount of accuracy, due to its hidden layer processing. [15]	Neural network makes the system complex. [15]
16	Face Detection and Recognition for Smart Glasses	Casado, C. A., López, M. B., Holappa, J., & Pietikäinen, M. (2015, June)	Here, in current paper we have developed a system which will detect face and recognise them in a smart glass. Parallel pipeline is used that reduces the latencies. In the current design native application scheme of Linux based mobile platform. Recognition is on the basis of local binary pattern (LBP). [16]	Local binary pattern and Parallel Pipeline	Good accuracy is provided. [16]	Latency and power consumption here is very high. [16]
17	Review and Comparison of Face	Dang, K., & Sharma, S.	We have reviewed few algorithms here so as to identify the best amongst various algorithms.	Viola & Jones, SMQT feature and	Gives a good understanding of all the mentioned algorithm and	Few recent algorithms are not covered. [17]

	Detection Algorithms	(2017, January).	Algorithms like Viola-Jones, SMQT feature and SNOW Classifier, Neural Network based face detection [17]	SNOW Classifier, Neural Network	provides the best one. [17]	
18	Detection and facial recognition for investigation	Detsing, J., & Ketcham, M. (2017, March)	Here we will be using, Eigen Face and SHIFT. If any suspect is found, the frame is captured. Then his face is detected from the frame and try to recognise it. This will help us to identify the suspect. [18]	Eigen Face and SHIFT.	Computation and complexity is less. [18]	There are a lot of fault face detection in this paper. [18]
19	Human Face Detection and Recognition in Videos	Tathe, S.V., Narote, A. S., & Narote, S.P. (2016, September).	In this paper an essential point is to limit the processing time for face identification and recognition forms. To annihilate noise and help increment of framework effectiveness. The framework is additionally partitioned into three sections, movement detecting, face detection and recognition. [19]	Background subtraction in haar cascade.	The advantage here is that it only selects the region of interest. [19]	Background subtraction increases the computational time. [19]
20	Survey of Face Detection on Low quality Image.	Zhou. Liu, D., & Huang, T. (2018, May).	Based on the benchmark dataset FDDB, we review performance of the current state-of-the-art face detectors, and comparing the design protocols of this algorithms. Then, finding out how their performance degrades when working on low-quality images with blur, noise, and contrast. [20]	Deep Learning and hand-crafted algorithms	Conducts face detection in low quality images. [20]	Other algorithms should have been tried for more knowledge. [20]

2.4.2 LITERATURE SURVEY

1. Face Detection and Recognition in Video.

Author: S.V Tathe, A.S Naote, S.P Narote.

Year: 2016

In this paper the author has proposed for detecting and recognising the individual appearing in front of camera. Initially, it will capture the video samples. Pre-processing is done that will remove the unnecessary artefacts in the image. Then it will detect face in a high complexity background. Later it will recognize the face detected in the camera view. Current system identifies an individual in high security area to stop the movement of unauthorized person.

2. Face Detection and Recognition using Raspberry Pi.

Author: Ishita Gupta, Varsha Patil, Chaitali Kadam, Shreya Dumbre

Year: 2016

The objective here is to investigate the effectiveness of facial recognition framework based on Raspberry Pi by utilizing regular face detection and recognition techniques systems. Strategies, for example, Haar detection and PCA. The proposed framework will take face recognition to next level in which the framework can supplant the utilization of passwords and RF I-Cards for access to high security area. Face Detection utilizing Haar cascade based course classifiers is the best strategy. The algorithm utilized here is PCA.

3. Parking Access System Based on Face Recognition

Author: Imene TALEB, Madani Mammar

Year: 2015

An entrance control vehicle framework in parking lot are dependent on camera introduced at the parking entry. Non adaptive strategy to distinguish the moving things is utilized, and propose a prototype to identify and perceive the face of the driver who needs to enter to the parking area and confirm in the event that he is permitted. Viola & Jones ideology is used for face detection and a new technique based on PCA, and LDA algorithm for face recognition is used. This paper, a biometric access

control device, which is based on the identification of vehicle driver face using a camera.

4. BENCHMARK FACE DETECTION USING A FACE RECOGNITION DATABASE

Author: Gee-Sern Hsu, Thu Ha Tran, Sheng-Lun Chung

Year: 2010

Proposed framework generates datasets for benchmarking face detection using database meant for benchmarking face recognition. Instead of the common way of collecting images manually, the datasets from the proposed framework are made by a synthesis process with two phases: intrinsic parameterization and extrinsic parameterization. The former parameterizes the intrinsic variables that affect the appearance of a face, while the latter parameterizes the extrinsic variables that dominate how faces appear on background images as required by a test criterion.

5. Rapid Face Detection and Annotation with Loosely Face Geometry

Author: Dr. P.Shanmugavadivu, Ashish Kumar.

Year: 2016

A rapid Partially Occluded Face Detection (POFD) with loosely face geometry technique based on feature-based method blended with part-based method is used. First stage detects the skin, and then local facial features are searched in skin region. This is an attempt to find the most probable face part candidates. In this approach, the devised algorithm aims to automatically detect face components individually and it starts from mostly un-occluded face component called Nose. Nose is very hard to cover up without drawing suspicion.

6. Face detection and recognition application for Android

Author: Monica Chillaron, Larisa Dunai, Guillermo Peris Fajarnes, Ismael Lengua Lengua

Year: 2015

The present work is focused on developing face detection and face recognition algorithms to be used by visually impaired people. Also, the Haar Cascades functions and the principal Component Analysis of the Eigen faces algorithms were used. The system is implemented on Raspberry Pi hardware and an interface for Android smartphones. Raspberry Pi camera Pi Noire runs under OpenCV libraries and C++ bindings for Python.

7. Face Detection and Recognition Method Based on Skin Colour and Depth Information

Author: Junfeng Qian' Shiwei Ma' Zhonghua Hao' Yujie Shen

Year: 2011

Improved face detection and recognition based on information of skin colour and depth. Obtained by binocular vision system. The face area was detected by using Adaboost algorithm. Afterwards, the real face was distinguished from fake one by using the skin colour information and the depth data. Then, by using PCA algorithm, face can be recognized by comparing the principal components of the current face to those of the known individuals in a facial database. This method was applied to a service robot equipped with a binocular camera system for real-time face detection and recognition experiment.

8. Design of Face Detection and Recognition System for Smart Home Security Applications

Author: Dwi Ana Ratna Wati, Dika Abadianto

Year: 2017

Face detection and recognition frameworks for smart home security service is proposed. Picture of an individual is gotten by means of webcam associated with MyRIO utilizing USB link. The face detection framework is constructed dependent on the template matching, while the face recognition depends on the PCA. The testing is done to analyse the execution of the face detection in various conditions such as change of distance, light intensity, light position

angles. The face detection model performances good in distance between the person and the camera is less than 240 cm. While the face recognition system has 80% of accuracy when it is tested using real-time image. The combination with password is needed in order to increase the security level as it is applied in real smart home security systems.

9. Face Recognition: A Holistic Approach Review

Author: Ghazi Mohammed Zafaruddin, Dr. H. S. Fadewar

Year: 2014

Aim of this paper is to provide a critical summary of the existing literature on human face recognition with reference to holistic approaches to face detection. In holistic based approaches recognition is done based on global features from faces, whereas in feature-based faces are recognized using local features from faces. Holistic approach features represent optimal variances of pixel data in facial images used to uniquely identify a person. Whereas features of feature-based approaches represent face features like the eyes, nose and mouth to uniquely identify a person.

10. An Approach to Face Detection and Recognition.

Author: Divya Meena, Ravi Sharan

Year: 2016

Face detection is a challenging task because faces are not rigid and it changes in size, shape, colour etc. Face detection become more challenging task when given image is not clear and occluded by any other thing and not proper lightning, not facing camera. In this research field some terms regarding face is “facial feature detection” means to locate the human face features such as eye, nose, lips, chin, eyebrows, mouth, ears etc. “Face authentication” is to verify the identity of a person. “Face tracking” is to track a face location in real time. “Expression recognition” is to recognize the facial expression of a face it happy, sad, surprising etc. “face localization” is to identify the location of a face.

11. An advancement towards efficient Face Recognition using Live video feed

Author: Dhamija, J., Choudhury, T., Kumar, P., & Rathore, Y. S.

Year: 2017

Face recognition has gained significant importance in today's world. Mobile phones, security services etc. everywhere face recognition has proved to be useful. Here, we are going to survey various face recognition algorithms that exists and provide an algorithm that will provide high accuracy, computation speed and efficiency. In this paper, a system provides live facial recognition. Our aim here is to focus on ways so as to consider how we can make an efficient surveillance and security assurance as and help organizations or government agencies to increase their security procedure to avoid crimes. A combination of PCA, fisherface and SVD models is used in this paper to gain high accuracy.

12. FACE DETECTION AND RECOGNITION FOR HOME SERVICE ROBOTS WITH END-TO-END DEEP NEURAL NETWORKS

Author: Jiang, W., & Wang, W.

Year: 2017

The aim of this paper is to propose an effective face detection and recognition system based on convolutional neural networks for home service robots. We have combined deep detection network based on the state of-the-art region proposal with the face embedding network. Here detection and recognition networks shares the same deep convolutional layers, this leads to significant reduction of computation. This network is robust to large occlusion, and scale, pose, and lighting variations. The experiment is mainly conducted on WIDER and LFW benchmarks. Using face detection and recognition a home service robot is also developed which will collect facial data and will train the model regularly.

13. Real Time Recognition of Human Faces

Author: Sameem, M. S. I., Qasim, T., & Bakhat, K.

Year: 2016

This paper proposes a simple and effective face recognition technique. This model is capable to recognize faces in single as well as multiple images of face stored in the database in real time. Here the algorithm used is viola jones algorithm. These stored images are cropped in order to make computation speed faster. SURF features are extracted from the stored images. The outliers are removed with the help of M estimator Sample Consensus. The face matching procedure is done using putative matching.

14. An Efficient Method to Face and Emotion Detection

Author: Reney, D., & Tripathi, N.

Year: 2015

Face detection, face recognition and face emotional selection has become the hottest topic nowadays. Also capturing images under various difficult conditions have also become easier. Any detection and recognition technique need a good set of database. Without that a good result or output is difficult to obtain. Here, we are going to create a face and emotion feature database, this database is then used to recognise faces and identify emotions. We have used Viola-Jones algorithm to detect faces, whereas for emotion detection we will be using KNN classifier. We have obtained an accuracy up to 95%.

15. Face recognition and detection using neural networks

Author: Bhandiwad, V., & Tekwani, B.

Year: 2017

Face detection and recognition is one of the most recent topic in biometric and one of the most secured methods. Face detection is also a challenging topic as various factors come into play. The current research work is done on MATLAB 2013. In current paper we will be performing face verification and recognition task. The face verification will detect and recognise the face from the database and provide access. The training data consists of 188 facial images. Neural

network used here gives a good amount of accuracy, due to its hidden layer processing.

16. Face Detection and Recognition for Smart Glasses

Author: Casado, C. A., López, M. B., Holappa, J., & Pietikäinen, M.

Year: 2015

Face detection and recognition is the most recent and exiting feature in various camera based devices. Smart glass is one of them. With the use of smart glass the details of the face which is detected will be shown on the glass. In this paper we have developed a system which will detect face and recognise them in a smart glass. Parallel pipeline is used hat reduces the latencies. In the current design native application scheme of Linux based mobile platform. Recognition is based on local binary pattern (LBP). Latency and power consumption here is very high.

17. Review and Comparison of Face Detection Algorithms

Author: Dang, K., & Sharma, S.

Year: 2017

Face detection and recognition has gained substantial growth in past few years. With many different algorithms available for face detection and recognition it is difficult to choose which one is the best amongst all. We have reviewed few algorithms here so as to identify the best amongst various algorithms. Algorithms like Viola-Jones, SMQT feature and SNOW Classifier, Neural Network based face detection are analysed and we will find out the best amongst these. From the above mentioned algorithms we conducted a test and we found out that Viola-Jones algorithm proved to be the best followed by SMQT.

18. Detection and facial recognition for investigation

Author: Detsing, J., & Ketcham, M.

Year: 2017

Face detection and recognition can be used to in improving security measures. This will help us to reduce crime rate to a great extent. Her we will be using, Eigen Face and SHIFT. If any suspect is found, the frame is captured. Then his face is detects from the frame and try to recognise it. If the suspects face matches from our database then he is successfully identified and can be arrested as soon as possible. This system is developed on MATLAB. There are a lot of fault face detection in this paper.

19. Human Face Detection and Recognition in Videos

Author: Tathe, S. V., Narote, A. S., & Narote, S. P.

Year: 2016

Here, we aim to propose a system for human face detection and recognition in videos. In this paper are primary aim is to minimize processing time for face detection and recognition processes. To reduce noise and increase overall system efficiency the system is further divided into three parts, motion detection, face detection and face recognition. Motion detection helps us to reduce the search area and complexity of our systems. Here we make use of background subtraction in haar cascade. This will increase our overall computational time of the system. The advantage here is that it only selects the region of interest.

20. Survey of Face Detection on Low-quality Images

Author: Zhou Y., Liu D., & Huang T.

Year: 2018

Various experiments and research have been carried out on face detection and recognition system. However, all the proposed model till now are verified using images of good quality which is not possible always, like for appliances like surveillance systems o other devices. Here, based on the benchmark dataset FDDB, we review performance of the current state-of-the-art face detectors, and

compare the design protocols of the algorithms. Then, we find out how their performance degrades while working on low-quality images with blur, noise, and contrast. Our results demonstrate that both hand-crafted and deep-learning based face detectors do not provide good results for low-quality images.

Chapter-3

Project Goals and Challenges

3.1 PROJECT GOALS

The following are the goals which will be accomplished by the end of this project:

- **Machine Learning:** This project is made with the concepts of the classical Machine Learning algorithm i.e. Viola-Jones algorithm. Here the author has used this algorithm with good knowledge of python and its libraries to get the desired solution.
- **OpenCV:** OpenCV is a computer vision and ML library. This library was built to provide an infrastructure for computer vision and involves the use of machine learning for commercial products.
- **Face Detection and Recognition:** The proposed work will be able to detect and recognise faces using the Viola-Jones algorithm and various python libraries. This will prove be a revolution for security services.

3.2 PROJECT CHALLENGE

In this specified passage we are going to talk about various challenges which is faced and come across while accomplishing this project and which needed various other solution to address such kind of the scenarios at the low level:

- **Light:**
For example, a slight change in lighting conditions has dependably been known to cause a noteworthy effect on its outcomes. In the event that the light will in general fluctuate, at that point; regardless of whether a similar individual gets caught with a similar sensor and with a practically indistinguishable outward appearance and represent, the outcomes that develop may appear quite different.

- **Background:**

The position of the subject additionally fills in as a huge supporter of the restrictions. A facial recognition framework probably won't deliver similar outcomes outside contrasted with what it creates inside in light of the fact that the elements - affecting its execution - change when the areas change. Extra factors, for example, individual expressions, aging and so forth contribute essentially to these varieties.

- **Pose:**

Facial Recognition Systems are very sensitive to pose varieties. The movements of face or contrasting POV of a camera can perpetually cause changes in face appearance and produce intra-class varieties making automated face recognition impossible to give results.

Chapter- 4

System Requirement Specifications (SRS)

4.1 HARDWARE AND SOFTWARE REQUIREMENTS

4.1.1 HARDWARE:

- **Processor:** i5 6th gen or above
- **RAM:** 8 GB or more
- **Memory:** 100 GB or more
- **GPU:** 940 MX or above

4.1.2 SOFTWARE:

- **Anaconda:** Jupyter Notebook
- **Python 2.7+**

4.2 TECHNICAL SPECIFICATIONS

4.2.1 OVERVIEW

In this section, we will discuss the technologies that have been utilized while making this project.

4.2.2 PYTHON

Python is one of the most recommended object-oriented programming languages for the machine-learning and its associated projects. It's recommended because it's having numerous pre-defined libraries and ample of function which makes things easy for the data scientists to the data analyst. It's also a high-level programming language.

4.2.3 ANACONDA

Anaconda is the versatile platform which consists the various tools required for the development to analysis of the data at the scientific level. It contains the tools for the Python programming language and R language both. It provides the one place from which you can control all the pre-defined libraries associated with both python and R. The popular tools of the Anaconda are Jupyter Notebook, R Studio, and Spyder.

4.3 LIBRARIES USED IN THE PROJECT ARE:

```
1 import numpy as np
2 import matplotlib.pyplot as plt
3 import cv2
4 import os
5 import sqlite3
6 from PIL import Image
```

Fig. 4.1 Libraries used in the Project

4.3.1 NUMPY

The numpy library is one of the most popular libraries for fast computing on the dataset. It is associated it the numerical python. It uses the function which is written in the C language so that the computational speed is much better than the other.It uses the concepts of the modern type of array (No array data structure is present in the python) i.e., numerical array.

4.3.2 OS

The specified module provides us a method of using operating system dependent functionality. It helps us to access our directories and files.

4.3.3 Pillow

The Python Imaging Library adds picture preparing abilities to your Python interpreter.This library gives file format support, a productive inner representation,

and genuinely ground-breaking image processing abilities. The core image library is intended for quick access to information put away in a couple of fundamental pixel positions. It ought to give a strong foundation for a general image processing too

4.3.4 SQLite

SQLite is a C library which gives a lightweight disk database that doesn't require a different server process and permits getting to the database utilizing a nonstandard variation of the SQL query language. A few applications have the ability to utilize SQLite for internal data storage.

4.3.5 MATPLOTLIB

The visualization of the results is one of the important step to showcase the results and various insights graphically. It contains various plots like bar, histogram and etc.

4.3.5 CV2

CV2 is a python library used to access OpenCV Library.

Chapter-5

Methodology

5.1 Overview

In the above section we saw all the software, libraries and the approach that we are going to use. Now in this approach we will see the algorithm that we will be using i.e. Viola-Jones face detection algorithm. We will discuss various features of Viola-Jones algorithm and how we are going to use it. We will be utilizing Viola and Jones algorithm to help us identify and recognise faces.

5.2 Viola & Jones algorithm

The traditional or original Viola & Jones algorithm consolidates shape and edge, face feature and template matching. Initially, the Haar-like component framework is utilized to adjust the face feature, and the feature evaluation is done with the help of integral image

Haar based features are grouped in three classifications: edge features, linear features, central features, and diagonal features, that have been joined into feature templates.

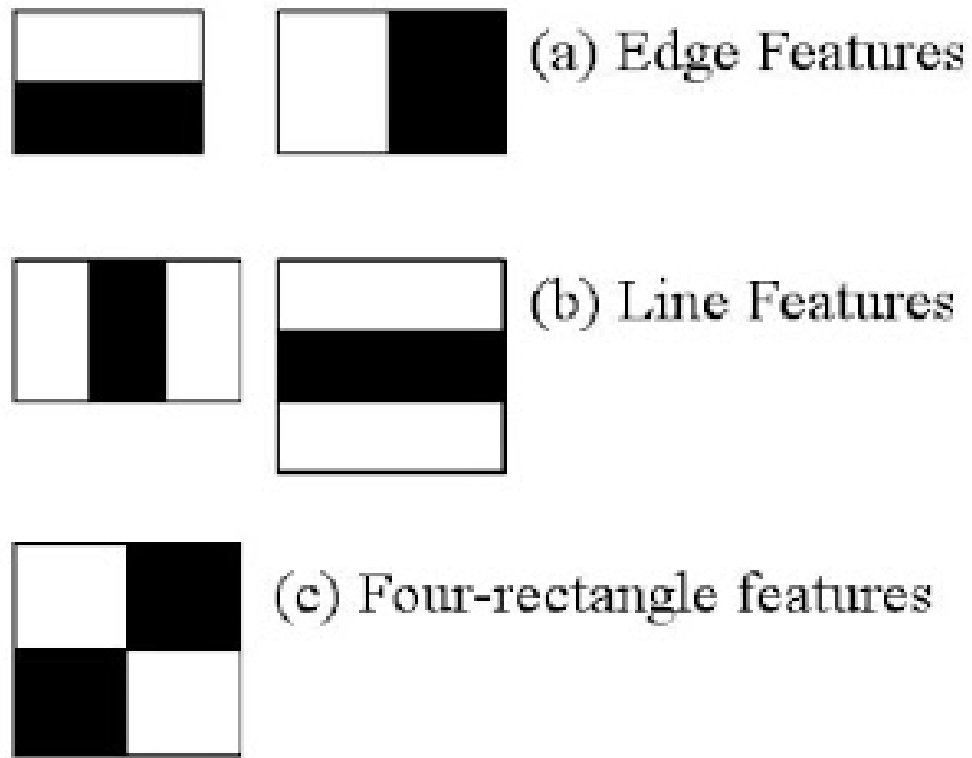


Fig. 5.1 Haar Features that are used in the project

Source: <https://jivp-urasipjournals.springeropen.com/articles>

It consists of black and white matrix in feature template, Eigen values of the format are characterized as white rectangular shape pixels whereas dark rectangular pixels subtracted. In Haar Eigen value mirrors the difference in the grayscale of picture. Let, a few highlights of the face can be essentially depicted as rectangular features; if you observe the eyes appear darker than the cheeks, the sides of the nose are more dark compared to the scaffold of the nose, and the mouth is darker than the encompassing shading. It has always proved to be more favourable to utilize features judgment than to utilize pixel just, and the speed of judgment is quicker. In any case, rectangular features are delicate just too straightforward graphical structures, for example, lines and edges sections, to help them to portray structure with explicit headings.



Fig. 5.2 Haar Features on Face for Detection

Source: <https://jivp-urasipjournals.springeropen.com/articles>

5.2.1 Integral Image

So as to register Haar-like highlights, it is important to aggregate every one of the pixels in the shape of rectangular area. Viola, Jones algorithm utilizes idea based on integral images. The integral image numeric value of any point in the picture is equivalent to the whole of the considerable number of pixels in the top left corner of the given point. By incorporating the picture from the graph, pixel aggregate of all fields in the picture perhaps acquired by one traversal of picture that extraordinarily enhances computational productivity for picture Eigen value.

We suppose that $SAT(x, y)$ hold integral image numeric value of points the (x, y) and let $I(x', y')$ hold gray numeric value of given pixel (x', y') in the integral image:

$$SAT(x, y) = \sum_{x' \leq x, y' \leq y} I(x', y')$$



Fig. 5.3 Integral Image Coordinate

Source: <https://jivp-euraspjournals.springeropen.com/articles>

The Formula for Recursion perhaps achieved by moving from left to right and also from up to down:

$$\text{SAT}(x, y) = \text{SAT}(x, y-1) + \text{SAT}(x-1, y) + I(x, y) - \text{SAT}(x-1, y-1)$$

Here, calculation proposed by Viola Jones utilizes a 24X24 base window measure, and that would result in excess of 180,000 features being determined in this window. The arrangement conceived for this computationally escalated procedure is to go for the Integral Image concept. The integral image means implies that to discover the entirety of all pixels under any rectangle shape, we essentially need the four corner values.

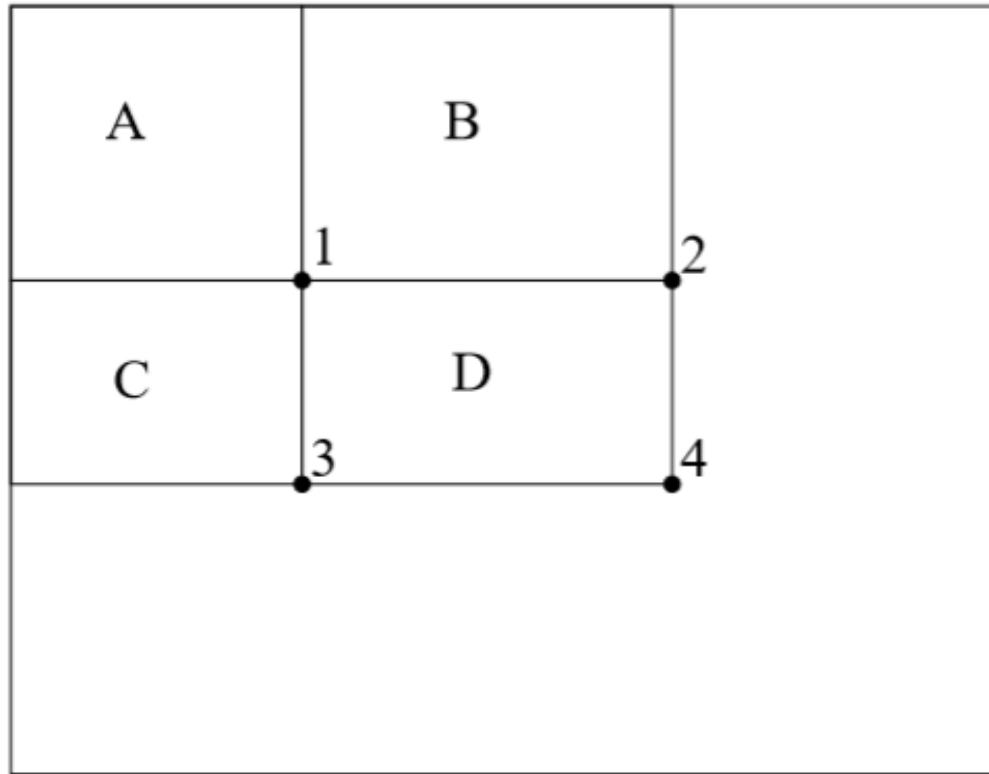


Fig. 5.3 Pixels in rectangular box

Source: <https://www.datacamp.com/community/tutorials/face-detection-python-opencv>

Summation of all pixels

$$D = 1+4-(2+3)$$

$$=A + (A+B+C+D)-(A+C+A+B)$$

$$= D$$

Similarly, the whole of pixels of any rectangular locale in the picture can be obtained. The top left corner directions of the given rectangular figure be illuminated hold x , y and the height and width of the rectangular figure to hold h , w , signified as a rectangular figure shape (x, y, w, h) . Equation is below:

$$\begin{aligned} \text{Sum}(x,y,w,h) &= \text{SAT}(x,y) + \text{SAT}(x+w,y+h) + \text{I}(x,y) \\ &\quad - \text{SAT}(x,y+h) - \text{SAT}(x+w,y) \end{aligned}$$

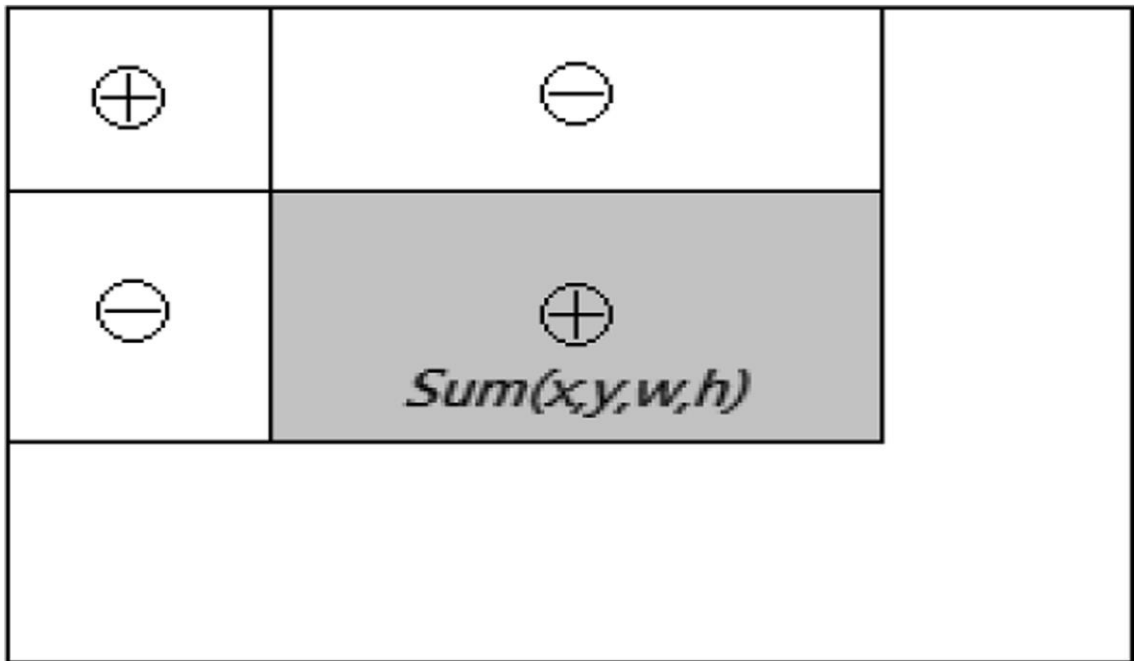


Fig. 5.4 Sum of all pixels

Source: <https://jivp-euraspjournals.springeropen.com/articles>

Here if we want to calculate the summation of pixels in a feature window, there is no need to add them up individually. We have to calculate the integral image by utilizing the values on the four corners.

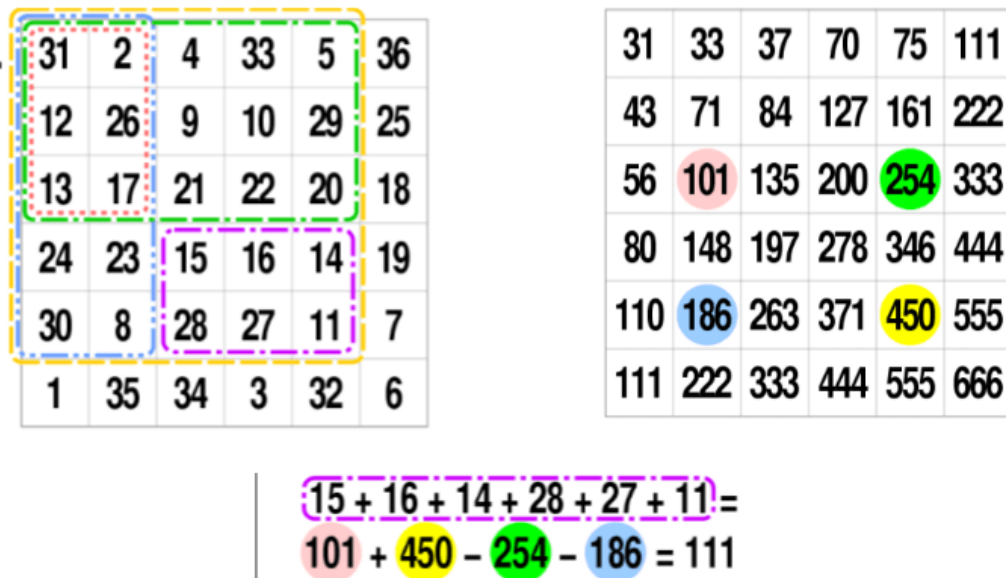


Fig. 5.5 Example for summation of pixels

Source: <https://www.datacamp.com/community/tutorials/face-detection-python-opencv>

5.2.2 Adaboost

As discussed out above, in excess of 180,000 number of features values result inside a 24x24 window. Be that as it may, not necessarily all of the features here are helpful for recognizing a face. Choosing the best element out of the whole piece, a machine learning calculation called Adaboost is utilized. What it basically performs is that it chooses just those features that assistance to improve the classifier accuracy. It does as such by developing a solid classifier which is a direct blend of various weak classifiers. This decreases the measure of features radically to about 6000 from around about 180,000.

5.2.3 Classifier - Haar Cascade:

Haar based feature classifier uses rectangular essential picture to discover evaluating a value. Haar based feature classifier does is that it accumulate the weight of each rectangular shape in its zone and the outcomes are incorporated. Couple of Haar based feature classifiers make a stage. The stage compactor totals all the Haar highlight classifier results in a phase and contrasts this summation and a phase edge. Each stage does not have a set number of Haar feature. Suppose, in the specified algorithm instructive gathering utilized 2 feature in the fundamental stage, 10 in the second. At the end they used a total of 38 phases and 6060 features.

Another path for which Viola Jones guaranteed that the calculation will work quickly is by utilizing a cascade of classifiers. The course classifier basically comprises of stages where each stage comprises of a solid classifier. Here, this is advantageous since it dispenses with the requirement to apply all features at once on a window. Rather, it bunches the features into isolated sub-windows and the classifier at each stage decides if the sub-window is a face. In the event that it isn't, the sub-window is disposed of alongside the highlights in that window. In the event that the sub-window moves past the classifier, it proceeds to the following stage where the second phase of features is connected.

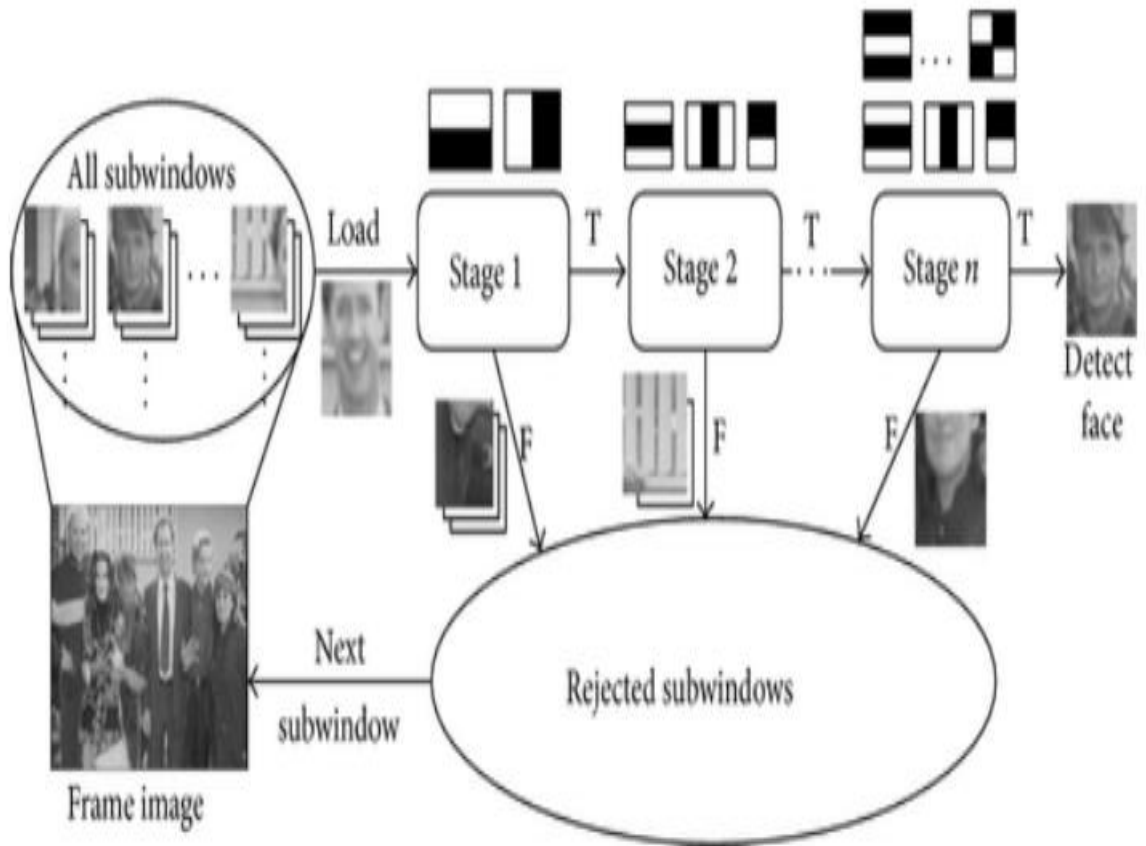


Fig. 5.6 Different phases of haar cascade classifier

Source: <https://www.datacamp.com/community/tutorials/face-detection-python-opencv>

Chapter-6

Design Approach and Details

6.1 PROPOSED SYSTEM

Today the most important part in any industry is its security and authentication of person. Data accessed by an unknown or non-reliable person may lead to a big loss for the company. Various techniques have been implemented for this purpose but one of the most recent and effective technique is face recognition. It is the most reliable technique to authenticate a person's identity. Not only in industries but it can also be used for crime detection.

Face Detection and Recognition has gained significant importance in recent few years. We can find this application from our mobile phones to high level security services. Face detection and Recognition has become a very integral part of our life.

Face detection and recognition is considered to be one of the fastest and most efficient biometric technology that has a primary purpose to identify human faces. The face detection and recognition system analyses the different attributes of a human face from images taken from a camera. It is one of the most efficient technique with minimum amount of delay and sometimes the subject is completely unaware of the process.

All the distinct features of the face are measured by the facial recognition technology (FRT). Around 80 nodal points are taken into consideration and creates a numerical code called as a face print. Various features may be taken into consideration this includes length of the jawline, distance between the eyes and the depth of the eye sockets, cheekbones shape, nose width etc. These measurements are stored in the database and then matched when a face is detected when a person stands in front of the camera.

Considering a CCTV security service, which triggers when it detects and recognises an individual from a hit list. Application of face recognition is increasing day by day. From mobile phone to security services. You can find it everywhere.

6.1.1 The face recognition has several stages of image processing:

1. Capture the Image

To recognise face you need a dataset. This data set consists of facial images of a subject or person whose face should be recognised. A required number of images are captured for the data to train on it.

2. Extracting the data:

Once these images are captured they should be stored in our database. All the required attributes or features should be extracted from the image. The attributes that are mentioned above are some common attributes.

3. Comparing with database:

Once our required data is extracted from the images, these attributes or features are then compared with the real-time or current subject. The subject's face is tried to match with the existing data in our database.

4. Matching:

Once the face is identified and checked in our database, here we will make the decision whether the subject's face matches with our database. All the features are checked and identified from our database and decided whether it is matching or not. Depending on the algorithm used this process just takes a second.

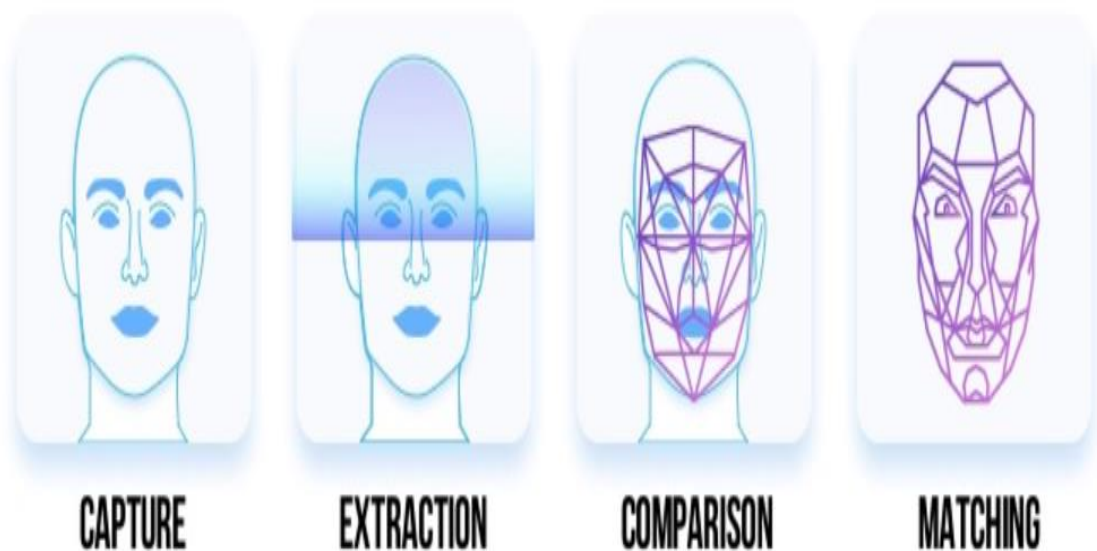


Fig. 6.1 several stages of face recognition in image processing

Source: <https://www.upwork.com/hiring/for-clients/pros-cons-facial-recognition-technology-business/>

Above we can see the various phases through which the facial recognition system works.

As we all know face detection and recognition system is being used in various fields. Here we have proposed this technique to be used in security purpose. Detecting and recognizing criminal face accurately is the most important part in the security system. Eventually we cannot trust a human memory to store the facial data for such cases. As a result we have to include machines for this purpose. Using machine learning for this security system can help us to enhance your security measures. In our proposed system of face detection and recognition, it provides one of the best methods/techniques to recognize criminals using Machine Learning algorithms.

With the support of OpenCV and haar cascade classification we are able to detect and recognize faces. At first, in our proposed method, we take 20 snapshots of the person. Along with the snapshots we provide ID, Name, Age, Gender and Criminal Records. The photo of the criminal is stored in our dataset folder. These photos are stored along with the ID.

When we want to recognise the face of the criminal or check whether a person has a criminal record or history we run the recogniser system. Where the face of the person is matched with our database. If the face matches with our database then the ID is fetched from the database and then all the required details is fetched from the SQLite database.

We will strive to provide maximum accuracy in our proposed technique. Here, we will first store the criminal faces and other details in our SQLite database. Then we will detect face in front of the camera. Finally, once the face is identified it is matched to our database and if the match is found the system will show details of that criminal.

6.2 DATASET DESCRIPTION

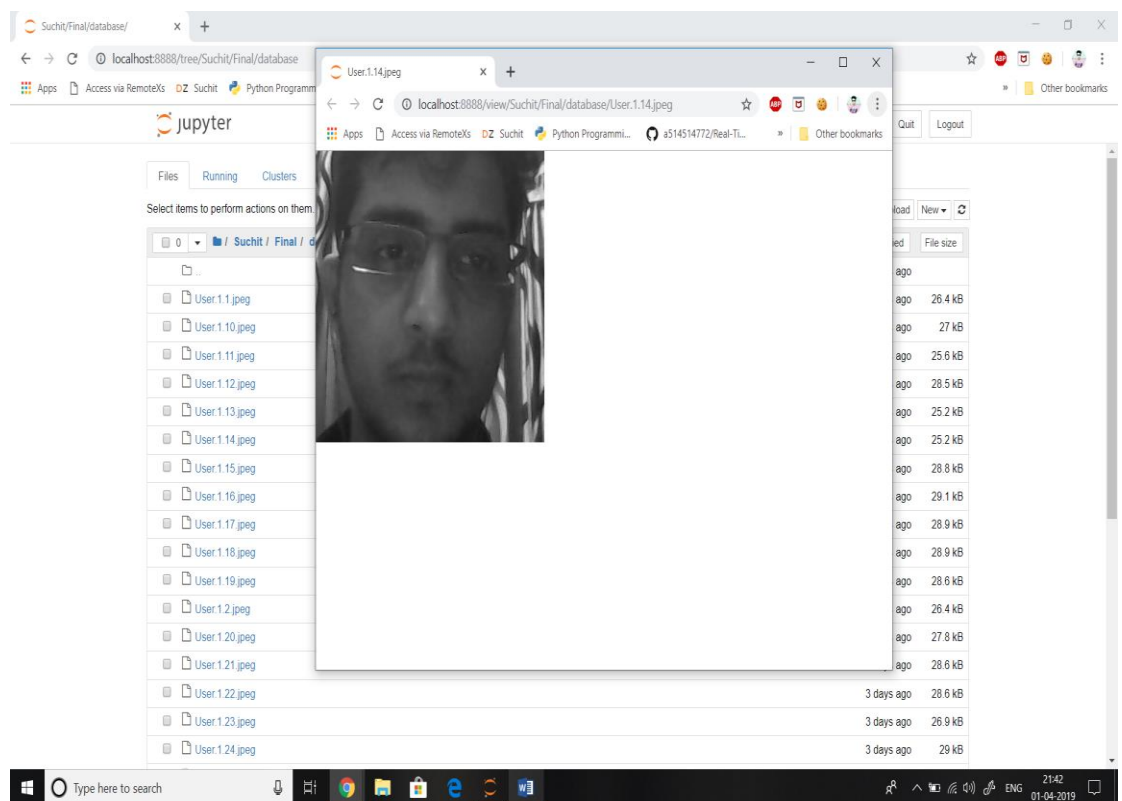


Fig. 6.2 Sample Database

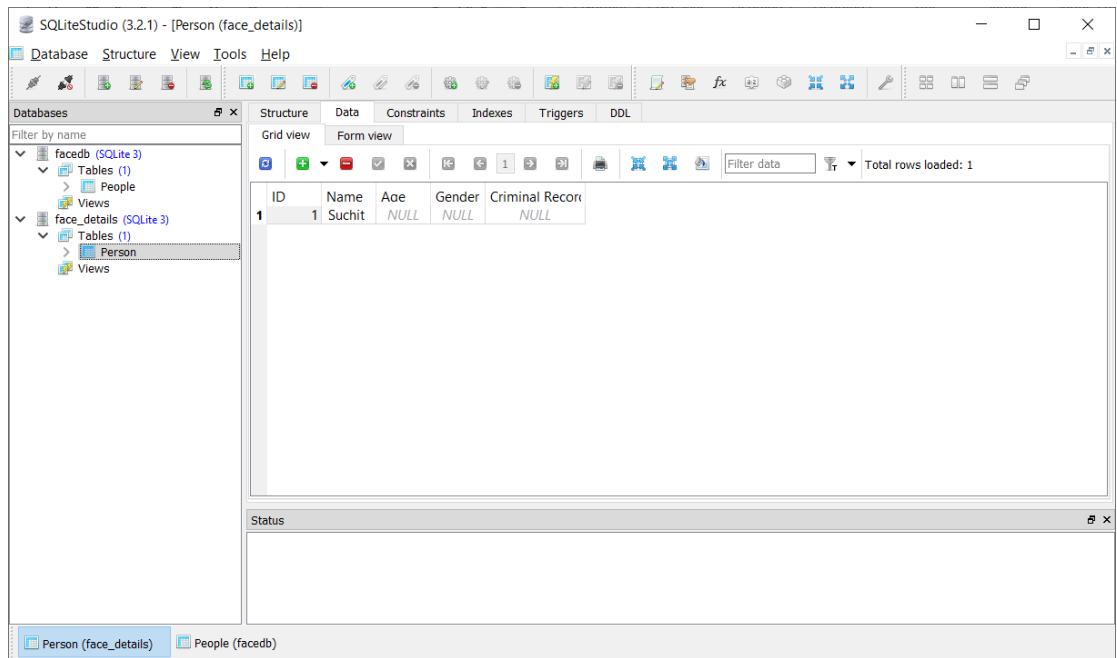


Fig. 6.3 SQLite database

Facial authentication is one of the most advanced and effective way of security. Here, we are developing a Face Detection and Recognition system where facial features play the most important role. We consider various attributes in a person's face which are unique and can be used for face recognition. Features such as size of the jaw line, distance between eyes, size of nose etc. are some of the features that are unique in each individual. In our current approach, our main focus is on person's face.

In face detection and recognition system, our primary focus is the facial data. We try to capture around 20 images of a particular person's face and then this data is stored in our database. This is in jpeg format. The image stored are used for matching with the data which it gets when a person is made to stand in front of the camera.

The images are stored in folder called 'dataset'. Here, 20 images per face are for training the model. It is an approach based on machine learning, where haar cascade classifier is trained by using few positive and few negative functions. This trained model is then used to detect objects.

Face detection and recognition is viewed as one of the quickest and most effective biometric innovation that has a main role to recognize human faces. The face detection and recognition framework examines the diverse properties of a human face from pictures taken from a camera. It is a standout amongst the most proficient procedure with high accuracy and the subject is totally unconscious of the procedure.

6.3 FLOWCHART OF THE PROJECT

The flowchart contains a group of exercises to be done so as to finish the assignment. Here, we will clarify the succession of the exercises to be done to finish our project. The succession should be the equivalent to finish the entire project.

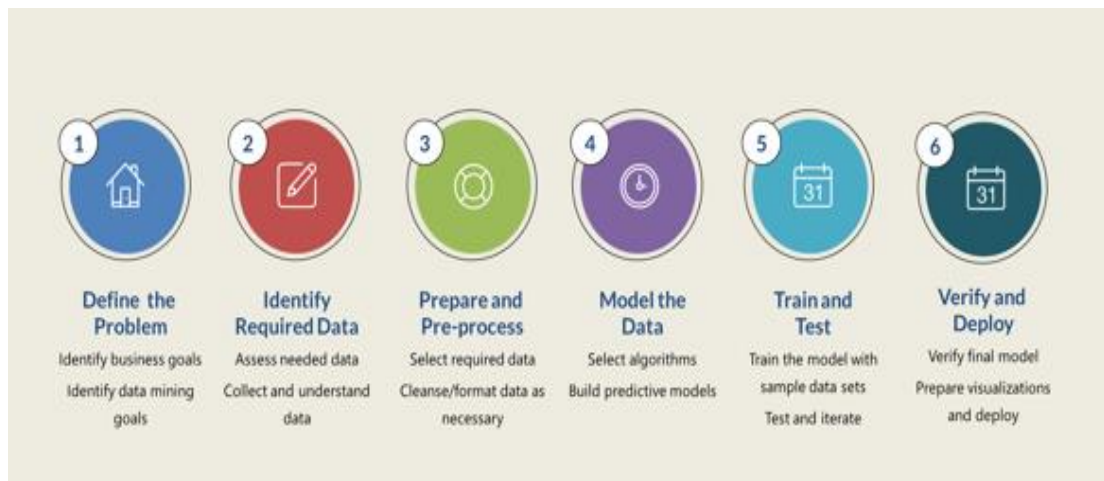


Fig. 6.4 Project flowchart

Source: <http://anternet.pw/data-mining-diagram.html>

6.4 SYSTEM ARCHIECTURE

In the system architecture we will see how the system works and the required step included in the face detection and recognition system.

a. Capturing and Storing Faces in Database

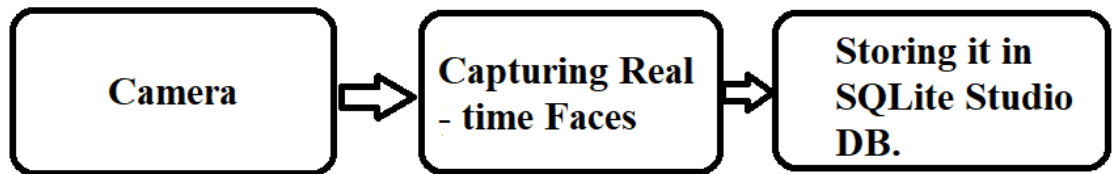


Fig. 6.5 Storing Faces in Database

b. Detecting and Recognizing Faces.



Fig. 6.6 Face detection and recognition process

6.5 MODULE DESCRIPTION

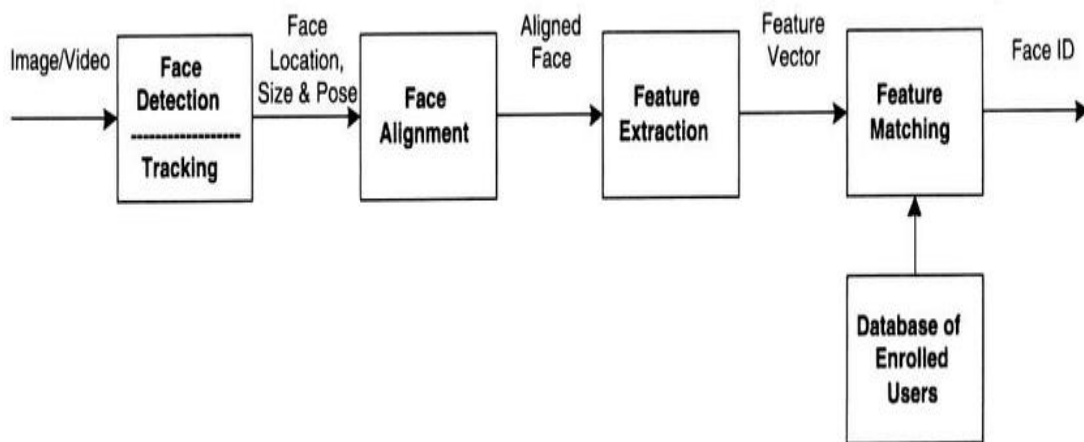


Fig. 6.7 Module Description of Face detection and recognition

Source: https://www.researchgate.net/figure/Face-recognition-processing-33-In-a-linear-subspace-Euclidean-distance-and-Mahalanobis_fig1_275715187

- **Face Detection:** The first thing is to detect or localize the face in the frame of the image. I.e. to differentiate face from the background.
- **Face Alignment:** This is to identify the pose and size of the face in the frame.
- **Feature Extraction:** To extract features such as length of Jawline, distance between eyes etc. for face detection.
- **Feature Matching:** To match these features with the existing images in our database. Match it with the details stored in the database.
- **Database:** To enrol or to add details of the user if he/she is using the system for the first time and save the details in the SQLite database.
- **Results:** Show the details of the user if his/her face matches with the details in the database.

Chapter-7

Implementation

7.1 Overview:

In this section we are going to talk about how we actually implemented this whole project. Till now we have discussed how machine learning, OpenCV, haar cascade works but now we will discuss how things were implemented as we proposed in earlier sections.

7.2 Flow of Implementation

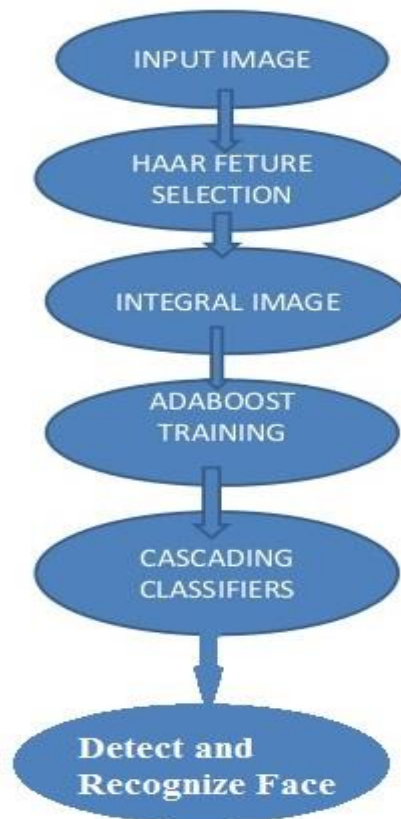


Fig. 7.1 Face recognition implementation flowchart

Source: <https://www.slideshare.net/SmritiTikoo/face-detection-62383927>

- **Input Image:**

The most important part of the face identification and recognition structure are images. These are the dataset of the images that we will be using to recognize a face. These images will be captured using the webcam. 20 images or snapshots per sample or user will be stored.

- **Haar Feature Selection.**

Based on the feature we want to identify a particular haar cascade feature is to be selected. Here we are using `haarcascade_frontalface_default.xml` file for feature extraction.

- **Integral Image**

So as to register Haar-like highlights, it is important to aggregate every one of the pixels within a rectangular locale. In this Viola and Jones algorithm utilizes ideology of the integral images. Value of integral images at any given point within picture supposed to be equivalent to whole of considerable number of pixel in the upper left corner of the given point.

- **Adaboost**

To just choose the best element amongst the whole piece, a machine learning calculation known as Adaboost is utilized. It basically does chooses just those features that assistance to improve and make the classifier more accurate.

- **Cascade Classifier: OpenCV**

With the help of OpenCV and haar cascade classification we have the ability to detect and recognize faces. It is a python library. It is used to detect and recognize faces.

- **Face Detection and Recognition**

The final step is to detect the face in front of the camera and recognize it by matching its details from the database.

7.2.1 Face Images

For face detection and recognition we need to compare the current face which is in front of the camera with the facial images which are stored in our database.

```
1 face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
2 video_capture = cv2.VideoCapture(0)
3
4 def insertOrUpdate(Id,Name):
5     conn=sqlite3.connect("C:\\Users\\suchi\\Desktop\\MCA\\MasterThesis\\face_
6     cmd="SELECT * FROM Person WHERE ID="+str(id)
7     cursor=conn.execute(cmd)
8     isRecordExist=0
9     for row in cursor:
10         isRecordExist=1
11     if(isRecordExist==1):
12         cmd="UPDATE Person SET Name=' "+str(name)+" ' WHERE ID="+str(Id)
13     else:
14         cmd="INSERT INTO Person(ID,Name) Values('"+str(Id)+"',' "+str(name)+"'"
15     conn.execute(cmd)
16     conn.commit()
17     conn.close()
18
19 Id=input('Enter your id')
20 name=input('Enter your name')
21 insertOrUpdate(id,name)
22 sampleNum=0;
23 while True:
24     # Capture frame-by-frame
25     ret, frame = video_capture.read()
26     gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
27     faces = face_cascade.detectMultiScale(gray, 1.3, 5)
28     # Draw a rectangle around the faces
29     for (x, y, w, h) in faces:
30         sampleNum=sampleNum+1
31         cv2.imwrite("dataset/User."+Id+'.'+ str(sampleNum) + ".jpg", gray[y:
32         cv2.rectangle(frame, (x-50, y-50), (x+w+50, y+h+50), (0, 255, 0), 2)
33         cv2.imshow('Video', frame);
34         cv2.waitKey(100)
35         if sampleNum>20:
36             video_capture.release()
37             cv2.destroyAllWindows()
38             break
39
40 enter your id1
41 enter your name Suchit
```

Fig. 7.2 Snippet for face image storage

The facial data will be stored in 'database' folder. Here each user will have 20 snapshots of his/her face. Along with the face images are given user id.



Fig. 7.3 Sample images of faces in database

The Above displayed images are stored with 'User ID' = 1 and 'Name' = Suchit. These images are stored in database folder as mentioned above and other details are stored in SQLite database where user id acts as a primary key.

7.2.2 Training the Model

Now once the images are stored and other details are entered. We have to train our model. This is necessary for the algorithm to learn which face is for which particular user id and other details respectively. This training file is stored in the 'trainer folder'.

```
1 recognizer=cv2.face.LBPHFaceRecognizer_create()
2 detector= cv2.CascadeClassifier("haarcascade_frontalface_default.xml");
3
4 def getImagesAndLabels(path):
5     #get the path of all the files in the folder
6     imagePaths=[os.path.join(path,f) for f in os.listdir(path)]
7     #create empty face list
8     faceSamples=[]
9     #create empty ID list
10    Ids=[]
11    #now looping through all the image paths and loading the Ids and the image
12    for imagePath in imagePaths:
13        #Loading the image and converting it to gray scale
14        pilImage=Image.open(imagePath).convert('L')
15        #Now we are converting the PIL image into numpy array
16        imageNp=np.array(pilImage,'uint8')
17        #getting the Id from the image
18        Id=int(os.path.split(imagePath)[-1].split(".")[1])
19        # extract the face from the training image sample
20        faces=detector.detectMultiScale(imageNp)
21        #If a face is there then append that in the list as well as Id of it
22        for (x,y,w,h) in faces:
```

```
21         #If a face is there then append that in the list as well as Id of it
22         for (x,y,w,h) in faces:
23             faceSamples.append(imageNp[y:y+h,x:x+w])
24             Ids.append(Id)
25     return faceSamples,Ids
26
27
28 faces,Ids = getImagesAndLabels('data')
29 recognizer.train(faces, np.array(Ids))
30 recognizer.save('trainer/trainer.yml')
```

```

1 %YAML:1.0
2 ---
3 opencv_lbphfaces:
4   threshold: 1.7976931348623157e+308
5   radius: 1
6   neighbors: 8
7   grid_x: 8
8   grid_y: 8
9   histograms:
10    - !opencv-matrix
11      rows: 1
12      cols: 16384
13      dt: f
14      data: [ 6.05536364e-02, 4.32525948e-03, 8.65051930e-04,
15              3.46020772e-03, 4.06574421e-02, 1.73010386e-03,
16              8.65051930e-04, 4.32525948e-03, 5.19031147e-03, 0., 0., 0.,
17              1.73010386e-03, 0., 8.65051930e-04, 0., 6.05536345e-03, 0.,
18              0., 0., 2.59515573e-03, 0., 0., 0., 7.78546743e-03, 0.,
19              1.73010386e-03, 0., 1.38408309e-02, 0., 3.46020772e-03,
20              1.73010386e-03, 2.59515573e-03, 0., 0., 0., 2.59515573e-03,
21              0., 0., 0., 0., 0., 0., 8.65051930e-04, 0., 0., 0.,
22              5.19031147e-03, 0., 8.65051930e-04, 0., 3.46020772e-03, 0.,
23              0., 0., 2.85467133e-02, 2.59515573e-03, 1.73010386e-03,
24              2.59515573e-03, 7.09342584e-02, 8.65051930e-04,
25              4.32525948e-03, 7.78546743e-03, 3.46020758e-02,
26              1.73010386e-03, 8.65051930e-04, 1.73010386e-03,

```

Fig. 7.4 Snippet of Model Trainer

7.2.3 Face Recognition

After data is collected and the model is trained, our system is ready to use. The developed face detection and recognition algorithm will show you the details of the person who is in front of the camera.

```

1 face_cascade = cv2.CascadeClassifier("haarcascade_frontalface_default.xml")
2
3 video_capture = cv2.VideoCapture(0)
4
5 def getProfile(id):
6     conn=sqlite3.connect("C:\\Users\\suchi\\Desktop\\MCA\\MasterThesis\\face_
7     cmd="SELECT * FROM Person WHERE ID="+str(id)
8     cursor=conn.execute(cmd)
9     profile=None
10    for row in cursor:
11        profile=row
12    conn.close()
13    return profile
14
15
16 rec=cv2.face.LBPHFaceRecognizer_create();
17 rec.read("trainer\\trainer.yml")
18 id=0
19 font=cv2.FONT_HERSHEY_COMPLEX_SMALL

```



```

20 while True:
21     # Capture frame-by-frame
22     ret, frame = video_capture.read()
23
24     gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
25
26     faces = face_cascade.detectMultiScale(
27         gray,
28         scaleFactor=1.1,
29         minNeighbors=5,
30         minSize=(30, 30),

```

```

26     faces = face_cascade.detectMultiScale(
27         gray,
28         scaleFactor=1.1,
29         minNeighbors=5,
30         minSize=(30, 30),
31         flags=cv2.CASCADE_SCALE_IMAGE
32     )
33
34     # Draw a rectangle around the faces
35     for (x, y, w, h) in faces:
36         cv2.rectangle(frame, (x, y), (x+w, y+h), (0, 255, 0), 2)
37         id, conf = rec.predict(gray[y:y+h, x:x+w])
38         profile = getProfile(id)
39         if profile != None:
40             cv2.putText(frame, str(profile[1]), (x, y+h+30), font, 2, (255, 0, 0), 3);
41             cv2.putText(frame, str(profile[2]), (x, y+h+60), font, 2, (255, 0, 0), 3);
42             cv2.putText(frame, str(profile[3]), (x, y+h+90), font, 2, (255, 0, 0), 3);
43             cv2.putText(frame, str(profile[4]), (x, y+h+120), font, 2, (255, 0, 0), 3);
44     # Display the resulting frame
45     cv2.imshow('Video', frame);
46
47     if cv2.waitKey(1) == ord('q'):
48         break;
49
50 # When everything is done, release the capture
51 video_capture.release()
52 cv2.destroyAllWindows()

```

Fig. 7.5 Snippet for Face Recognition

Chapter 8

Results

Here we can see that the face is detected and other details are displayed as they are stored in the database.

8.1 Following are the details displayed.

1. Name : Suchit
2. Age : Unknown
3. Gender : Unknown
4. Criminal Record: None.

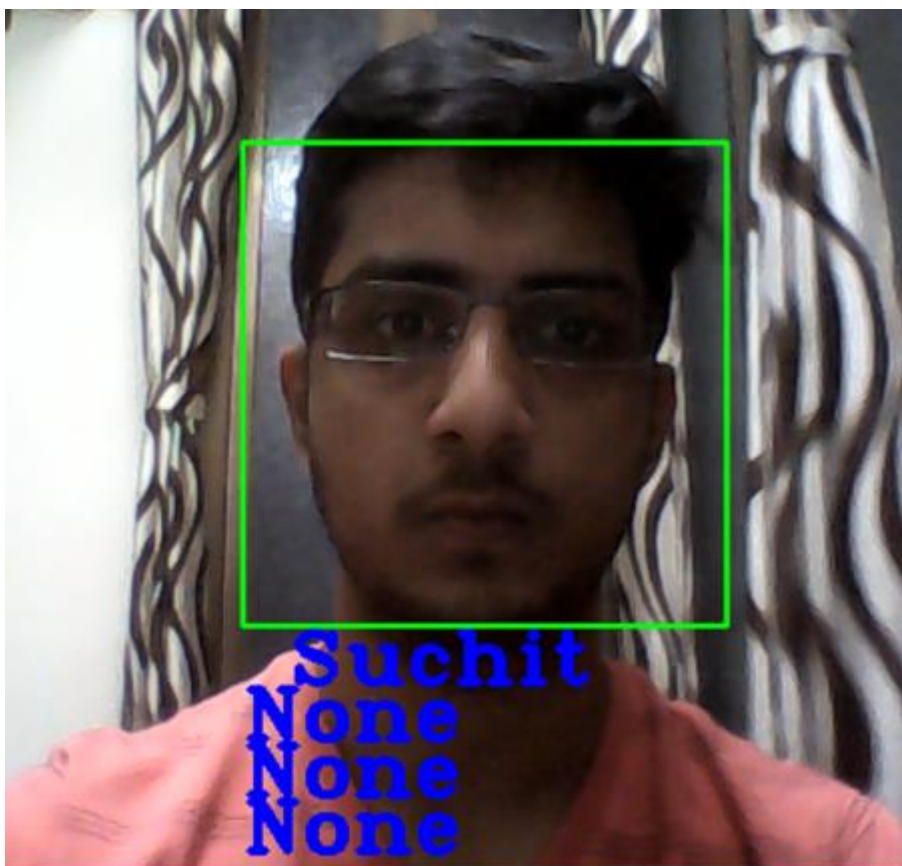


Fig. 8.1 Results of the Project

Chapter 9

Conclusion and Future Work

9.1 CONCLUSION

Face detection and recognition is one of the fastest growing technique. This technique is used in various field, right from mobile phones to security purpose. Today our aim here is to provide such a technique for criminal face detection. Here we have used an improved version of Viola-Jones Face detection Algorithm where we have made the data storage more efficient and along with that OpenCV and haar cascade classification for our face detection and recognition purpose. Haar cascade being considered to be most reliable as compared to other cascade classifications. The model will be used to recognize faces and display all the available details of the recognized person.

9.2 FUTURE WORK

Future work of the proposed work will be to include object detection which can be used along with drone. There are many situation where directly going forward without knowing what is going to come ahead can prove risky and especially when it a purpose of security. So in this case a drone can be used to send it before the person in charge and scan through the place and avoid any unnecessary risk. This drone will contain a camera and it can be seen by a remote. On the screen and object detection algorithm will help to analyse the data coming from the drone and detect all the object. The model can be further trained to recognise harmful objects.

Chapter 10

References

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