GENDER IDENTIFICATION USING FACIAL FEATURES

Project report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology

in

Computer Science and Engineering

By

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Under the supervision of

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to

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CANDIDATE'S DECLARATION

I hereby declare that the work presented in this report entitled " **Gender Identification Using Facial Features** " in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology in Computer Science** submitted in the department of Computer Science &Engineering and Information Technology, Jaypee University of Information Technology Waknaghat is an authentic record of my own work carried out over a period from August 2019 to May 2020 under the supervision of **Dr. Jagpreet Sidhu** , Assistant Professor (Senior Grade), Department of Computer Science & Engineering and Information Technology.

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

S.Singla

27/05/2020

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This is to certify that the above statement made by the candidate is true to the best of my knowledge.

Dr. Jagpreet Sidhu

Assistant Professor (Senior Grade)

Department of Computer Science & Engineering and Information Technology

Dated : 27/05/2020

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Last but not least I would like to express my sincere gratitude to my family members who stood by me and stopped me in every phase of this project and gave me the much required moral support in carrying out this project successfully.

Shubham Singla

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LIST OF ABBREVIATIONS

ML	Machine Learning
PCA	Principal Component Analysis
KNN	K-Nearest Neighbour
IP	Image Processing
AI	Artificial Intelligence
FB	Facebook
SVD	Singular Value Decomposition
APK	Application
DNN	Deep Neural Network
CNN	Convolutional Neural Network

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ABSTRACT

The recent time has created growing demands in the field of AI, ML and their various application areas and one of such areas that is trending today is the face recognition as it has attracted lots and lots of attention in the recent years. Using face has an advantage and the advantage is that it has an upper hand due to its identity in case of other alternate methods available, like take the case of fingerprint identification, this basically relies on the fact that its quite easy to use and this is the reason why this is so well accepted by the people across the world as it doesn't involve any interaction at a physical level of the user and with the system and this yields a better result. The target of the project is to try to recognize the gender of an individual by taking a look at his/her photo. This is an instance of supervised machine learning where the training of the algorithm is firstly done on the dataset which consists of male and female faces, and this system is then used to classify new data accordingly. The point to be noted here is that no other genders other than Male and Female were taken into the consideration. Before starting with the process, preliminary algorithm is executed so as to make sure that the image provided as an input is that of a human and only afterwards the classification begins. While the attempt is made at identifying gender from facial features, curiosity about identifying what features of the face are required or important so as to determine the gender. Now the question arises if the localized features such as ears, nose and eyes are more important when compared with overall features that includes face contour, hair line and head shape.

CHAPTER-1

INTRODUCTION

The recent trend of technology has been mostly centred on Artificial Intelligence and Machine learning along with Big Data Analytics. More and more researchers have taken up these fields and started carrying out research in them. More and more start-ups can be seen working on products based on these technologies. The facial detection using various techniques constitute a major part of the technologies such as Machine Learning, Image Processing, Deep Learning. Analysing various facial features with the help of Image detection using various machine learning algorithms and implementing neural networks for real time detection is one major element of the project.

1.1 MACHINE LEARNING

ML or the machine learning is a subset or one of the application of Artificial Intelligence i.e. AI which keeps learning from the past and new test datasets and tries to improve the performance and accuracy every time based on datasets provided.

1.1.1 WHAT IS "MACHINE LEARNING"?

"**ML in other words focuses on such a development which involves kinds computer programs"** which means data is provided and accessed and from the data the model tries to learn themselves.

The learning phase usually has to begin with the obs from the datasets, which include such egs, any experience previously, or such a instruction that looks for some kind of patterns in data and decisions that need to be made better in the future whose basis remains the examples that are provided by the user. The primary aim remains usually to allow whichever and whatever computers can learn automatically i.e. without any kind of human intervention or assistance and the actions need to be adjusted accordingly.

1.1.2 Applications of Machine Learning

AI or the Artificial Intelligence is all over the place. Plausibility is that you are utilizing it in one or other manner and you don't realise it until told like the recommender systems at various e-commerce websites which tracks you web surfing data on their platform.

The well-known utilizations in the field of AI is ML i.e. Machine Learning, in which various softwares, and gadgets can be seen performing by a means of perception (fundamentally which is just the same as human cerebrum).

Below listed are some of the applications in the field of ML:

- **Personal Assistants (Virtual)**

  Siri, Cortona, Alexa or Bixby, the latest devices in home automation are just few names or examples in case of few of the famous instances. As per the name that it suggests, also these devices help with reading data, when asked using voice assistant. ML is just another important part of personal assistants because they are supposed to be collecting and refining whatever the information, basis of which is includes previous involvement with the user. The dataset is utilized so as to render results that can be tailored as per your preferences.

Fig 1.1: Home Assistants [2]

- **Videos Surveillance**

  An individual who is monitoring several video cams at one time! The difficult job would be to do once at a time and to be honest that can be at times boring as well. Instead of using several humans it's better to train a computer to do the same task based on some ML algorithm.

  The modern video surveillances systems come nowadays equipped with the latest developments from the field of AI which makes at several times things helping in detecting crime even before it happens. Usually these AI monitored cameras track any unusual or suspectful behaviour an example of which includes a person who for a long time stands motionless, lying or falling asleep and not moving etc. The various security systems installed, gives an alert to the secuirty incharge, and this can help to avoid some mishappening. And incidents or such activities that are True Positive i.e. reported and on taking action found to be correctly true, constantly improve the surveillance and security services. ML works at the backend and does all the job by improving constantly.

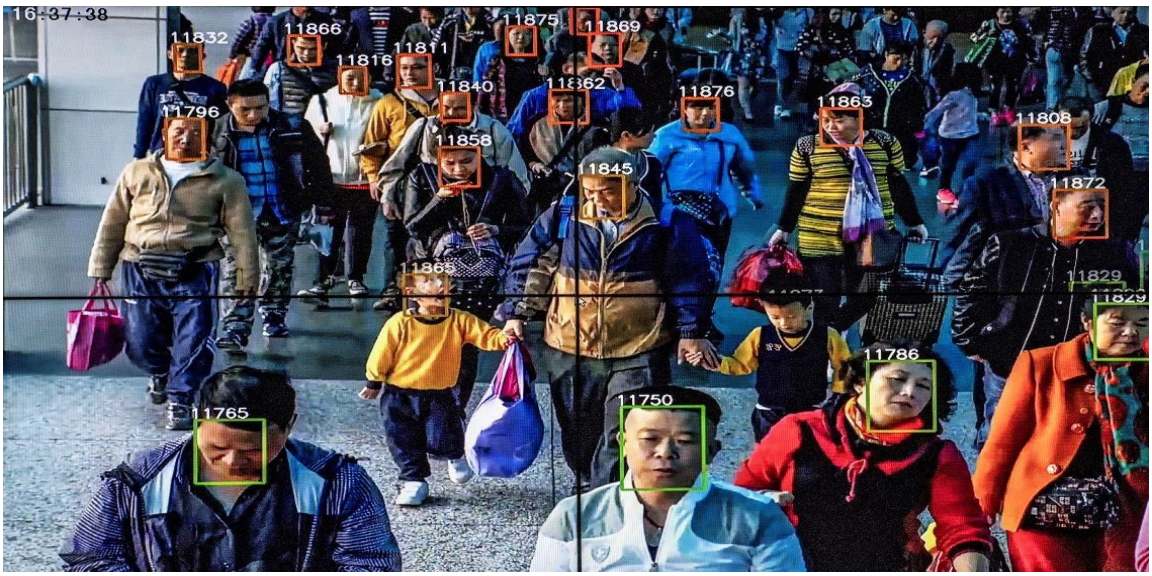

Fig 1.2: Surveillance [2]

- **Social Media Services**

  Getting personalized update about your news feed and ads targeting as per search history, social media platforms at the backend use machine learning for personalizing user benefits.

  Here are a handful examples that a user must be noticing, seeing, using and developing an interest in your social media accounts, without even realizing that these amazing features are just another application of ML.

  - "People You May Know":

    The basic working of ML is of understanding and then analyzing to learn everytime. FB endlessly monitors your feed of friends that a FB user wish to connect or recently connected with, the profiles visited by you, as per your interests, could be your fellow employee, or from group that you may share with nobody an so on. The basis of unceasing learning, data containing lists of people on FB that can be recommended to help a user become new FB buddies.

Fig 1.3 Social Media [2]

  - Face Recognition*:*

    When a user uploads any picture could be of the user or with a friend and FB with help of Ml and Face Recognition instantly recognizes the friend you uploaded your picture with. FB checks the posts and your poses along with prognostications in image, the features that are exclusive are considered.

It accordingly matches with similar FB users or people you should have in the friend suggestions list. At frontend the working looks easier but the entire process when looked from the backend is very complicated and the precision factor needs to be taken care of.

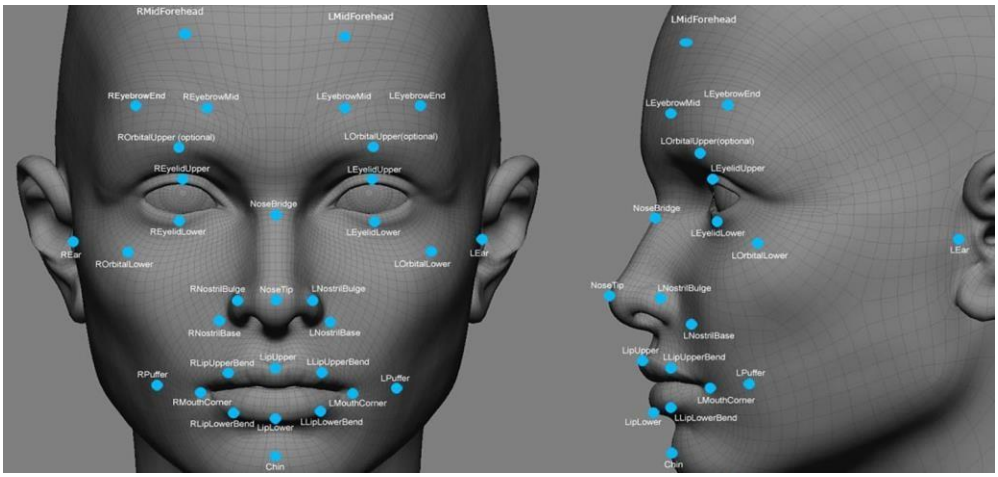

Fig 1.4: Face Recognition [2]

- Similar Pins*:*

  ML forms the core element of the Computer Vision and a technique that extracts very useful information of user's profile that could be from images or videos. The platform Pinterest can be seen using this application of ML to identify various objects & recommends the user similar pins accordingly.

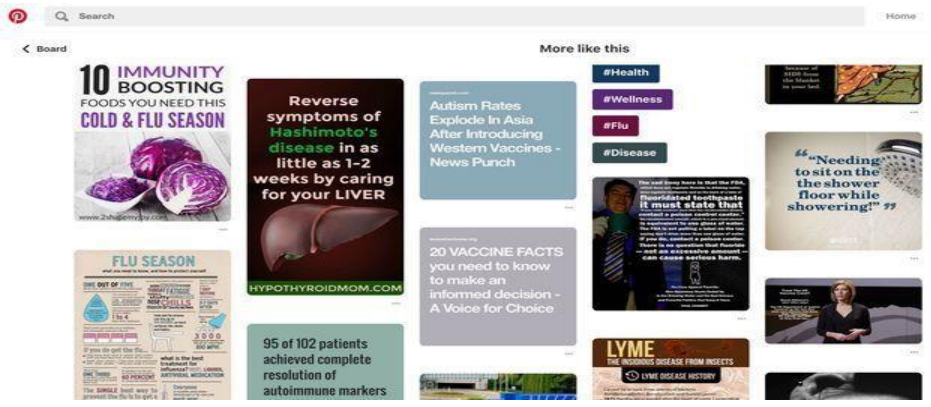

Fig 1.5 Pinterest [3]

1.1.3 Machine Learning in facial recognition

ML when it comes to recognition of face uses a technique that can be used to recognize and detect human faces of any and every individual whose pictures or images stored in the dataset. Besides this there are other methods for identifying which maybe more accurate, this technique remains a very significant and important point of focus for research as its non-meddling nature also, it can be a method to identify a person i.e. can be used as people's facile method for personal identification. Few methods include:

- **Geometric Based / Template Based: -**
  Algorithms that do face recognition are sometimes known a geometry or template based algorithms. The first method makes use of tools that are statistical in nature also known as template-based methods which maybe Support Vector Machines or SVM, Principal Component Analysis or PCA, Linear Discriminant Analysis or LDA, Kernel.
  The geometric methods which are based on features are the second method, they usually examines indigenous facial features and their relationship geometrically. The other name for this method is feature-based method.

  - **Principal Component Analysis: -**
    PCA is commonly used and one of the cited method which is Principal Component Analysis for statistical tools.Procedure mathematical in nature that accomplishes dimensionality reduction with help of extraction of the principal component that is based on this multidimensional data.

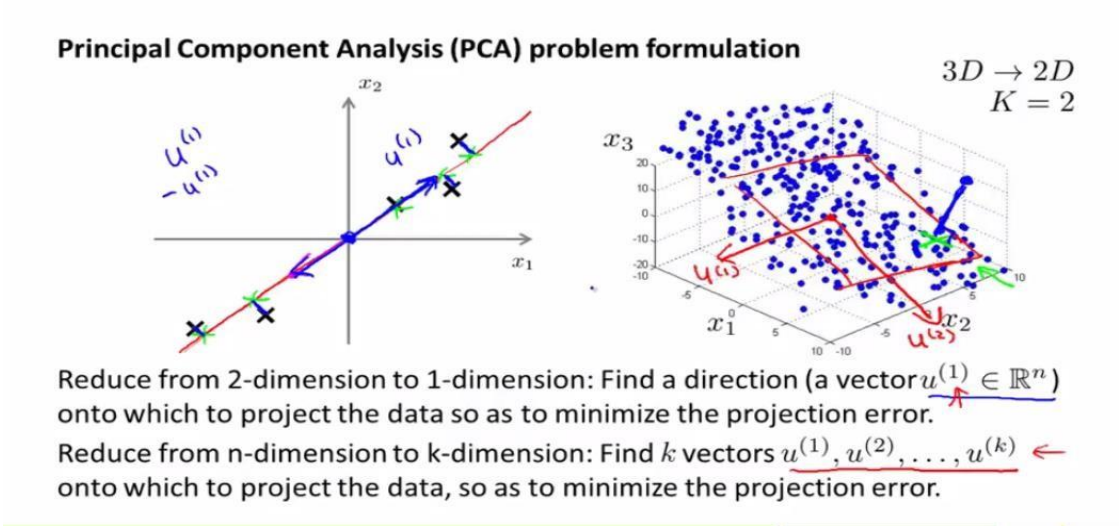

Fig 1.6: PCA [3]

- **Support Vector Machine [SVM]:-**Supervised ML

  algorithm includes SVM that is usually used for classifying and also at times for regression challenges. But usually can be noticed in case of classification problems. There's a set that consists of training examples, marked that belongs to one or the other of the mentioned two categories, the SVM training algo builds such a model that is used to assign new cases to any category, which makes it np binary linear classifier.

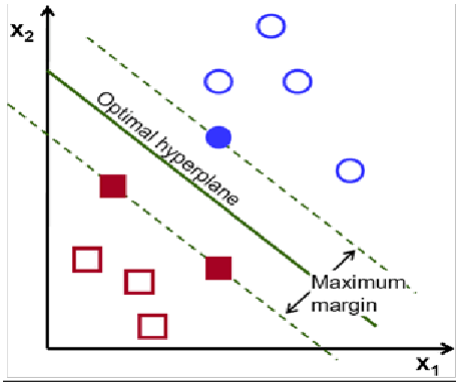

Fig 1.7: SVM[3]

- **Holistic: -**

  The relative features of the face or their linkup to function with human face completely has not endured in to the extent, researchers have followed various kinds of approaches, trying to find out what the most significant characteristics. Different approaches, use different facial features. Methods such as Hidden Markov Model falls into the same category, and processing of features in face recognition is well known.

- **Appearance or Model being Basis:-**

  This method depicts a appearance of human face by means of facial features inregards to more than a few images. A high dimensional vector is considered to be a good image. The technique is based so as to derive the required facial feature from the image at the backend. The training set is cross examined with the help of a random sample image.

  The appearance-based method is used for classifying a face as linear or nonlinear. The example of this method includes- PCA, LDA etc used as a direct approach else Kernel PCA maybe used as a nonlinear approach. In another case this model based method maybe classifie: nD where n=2 or 3.

  Like: Elastic Bunch Graph Matching possibly.

Here in our project the methods that we have used include **SVM** and **PCA.**

1.2 Image Processing

IP or Image Processing [1] alludes the handling kinds of pictures utilizing tasks that might be scientific such that they can be upgraded and improvement maybe made to the nature of pictures and distinct helpful data extracted from them. That is I.P. could likewise, characterized to changing to a meaning over a picture into the computerized structure in form that contains digital information.

One might likewise want to characterize the image processing as study that can be used to form a digitalized image for the most important part to improve the picture.

When at some point the picture is represented n-dimensional where n=2 Image processing [1] for the most part alludes to preparing of image as digital and the handling of the image optically is likewise practical or else attainable. Likewise one can simply prepare an image too i.e. analog processing. Handling of a picture likewise incorporates evacuation of noise or whatever other distorting factors such as inconsistencies that can be found in the image being considered.

Fig 1.8 Image Processing [3]

Fn i.e. function - f(x,y): x,y , the coordinates which are used to represent the plane directions and function(f)'s magnitude calculates the data about the intensity by point represented.

With a limit and making discrete values use for the mentioned coordinates or known previously, and picture turns into an advanced picture which is known as digital image if height is also known.

1.2.1 TYPES OF AN IMAGE

a) **BINARY IMAGE**– The image is said to be a binary image as the term's name recommends i.e. contains just two pixel components which are 0 and 1,now these two represent something- 0 represents dark and 1 represents white. Monochrome is the other name for the binary image.

b) **BLACK AND WHITE IMAGE**– The picture or the image which is being used usually comprises of mostly just the high contrast shading which is known as "BLACK AND WHITE IMAGE".

c) **COLOR FORMAT (8b)**– This format represent 8 bit, the most celebrated format seen in an image. This format consists of around 256 distinct shades of hues and also this is regularly known as Grayscale Image. The organization is usually used to term or refer to something similar seen in Binary Image, 0 is used to represent Black, and 255 is used to represent White, and 127 is used to represent dim.

d) **COLOR FORMAT (16b)**– This format represents 16 bit, a colored pic format known to have around 65,536 different colors. The other name for this format is "High Color Format". This "16 bit format" is used to divide it into formats: RGB format, divided into "Red"," Green" and "Blue".

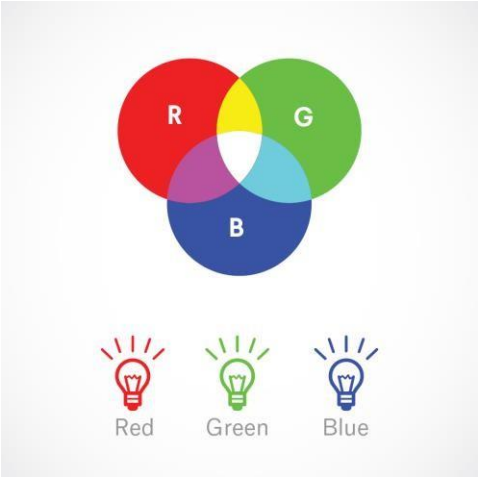

Fig 1.9: RGB [4]

1.2.2 USES OF IP or IMAGE PROCESSING (DIGITALIZED):

The Digitalized Image Processing [1] procedure is by large equated with the evolution of the particular system to process digital images.

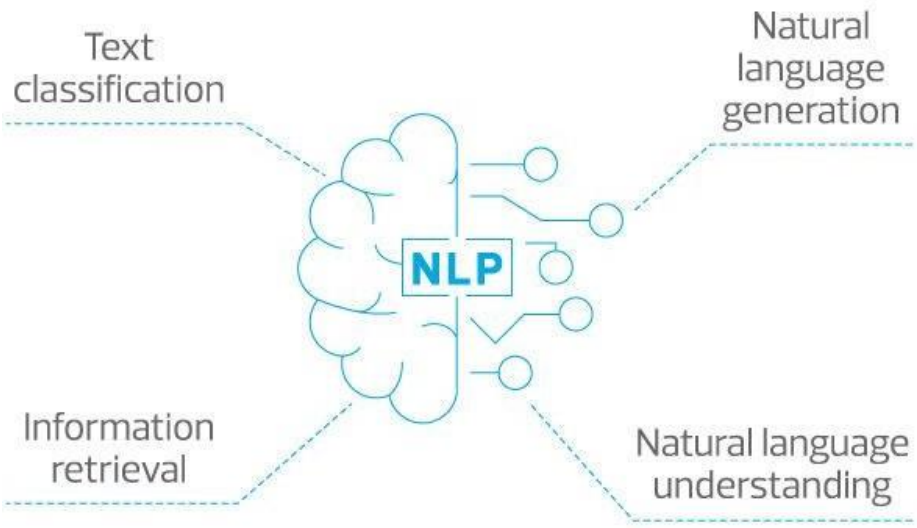

Fig 1.10: IP [4]

It finds various application of different uses [2] and a portion of the zones where computerized picture handling assumes significant job are:

• MEDICAL FIELD [2]

In medical sciences field this technique of image capturing and handling for generating computerized pictures in future can make a breakthrough to open human bodies.

• REMOTE SENSING [2]

Related to restorative applications viz. data nearly out of reach territory gets valuable with the assistance of picture handling.

• Color PROCESSING [1,2]

Giving a particular shade so as to verifiable of the picture is very simple and that becomes simpler with the assistance of picture handling.

• ENCODING [1,2]

The information that data contains must be encoded with-in the numerous pictures at whatever point the security of data or the information provided is thought about and considered accordingly.

• VIDEO PROCESSING [1]

The quick development of pictures is nothing but a video, the pictures in a continuous motion are termed as and can be seen as a video. With the assistance of picture handling the attempt is made to wipe out or lessen the undesirable commotion and furthermore an attempt is also made to identify the movement of items or the various objects and so on.

Since we have just experienced that the presentation of processing of image and different uses it has, we can now shift our focus and talk around more intriguing region namely Facial Recognition which is the very core for the project implementation.

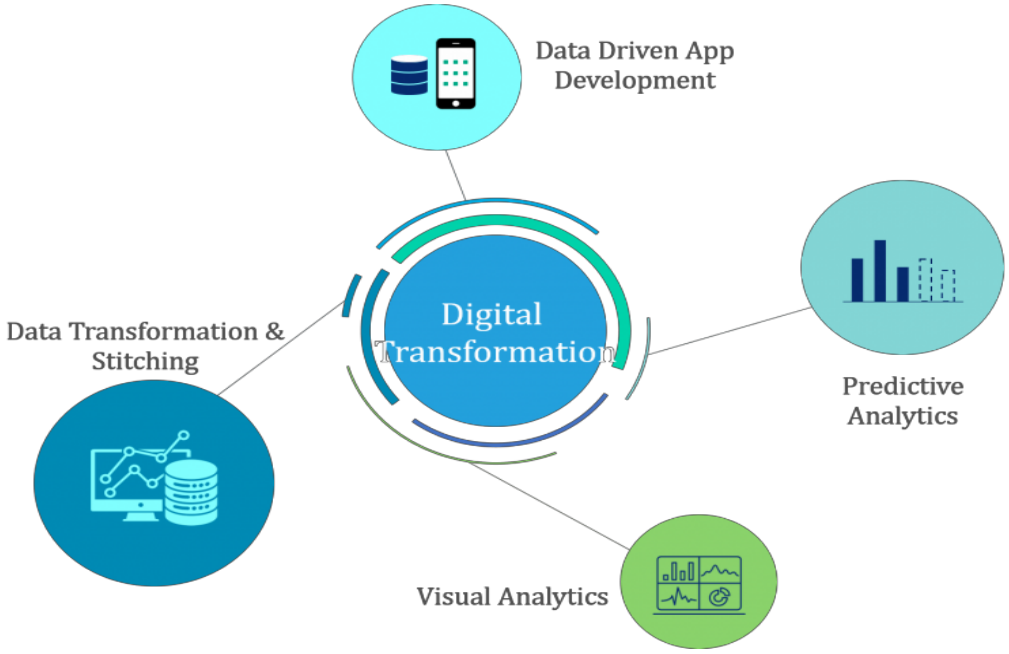

Fig 1.11: Apk of IP [4]

1.3 FACE RECOGNITION:

In face recognition the most important and intriguing role is played by the “Human face”, the intriguing variable while communicating various or any perspectives or in the sense of starting a different sort or kind of discussion and is used to utilize the human face which as the same looks just as the securing of another way and this has gotten more prominent or a very efficient consideration in recent years.

Recognition of face [3] is only preparing the computer machine so as to perceive the face most effectively and productively from the given kind of arrangement of the data provided or the information.” Face Recognition” the latest innovation which fits for one of the distinguishing individual's face that can vary from video posted outline to the computerized or the digital picture/image. A sort of biometric framework, facial recognition, that maybe and is being used progressively for more and more powerful components when used to compare with various sorts of biometrics as the client that

needs not to again reach the framework and there are a few different issues that are related to unique mark biometric [3] and in a way at multiple or plenty times it gives outcomes which can generate an error. There have been different situations which arise when biometric gave a false result for the person identity. So face recognition is a better approach for the person identity.

Fig 1.12: Face Recognition [3]

1.3.1 APPLICATIONS OF FACE RECOGNITION:

Face Recognition which can be noticed in various fields has its important in these different fields that include the safety, surveillance and security usually at high-tech places.

Above several face recognition applications some of these are as follows-

- **ENTERTAINMENT [4]**

The most active social media sites or applications which include Facebook, Snapchat can be seen or noticed utilizing the face recognition technology to provide security to the people accessing and using their platform. Also, similar to these social media apps the

same technology can also be seen being used in the virtual games like the VR and movies that run various 3D or maybe 5d shows can be noticed using such techniques.

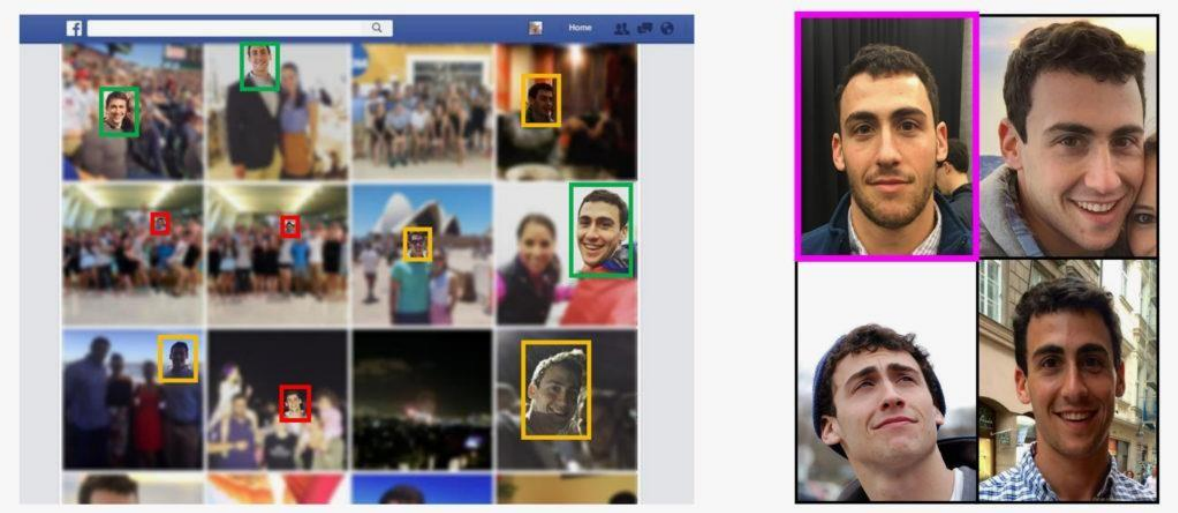

Fig 1.13: Entertainment [3]

Above image depicts how FB is using the face recognition tech to identify the particular man in the profile and then trying to unlock your account using the same technology if you forget your password.

- **SECURITY [4]**

Latest gadgets can be seen using face recognition for device login commonly lnown as FACE-ID or face unlock which unlocks your device within fraction of seconds based on your features, Encrypting various files etc.can be seen utilizing or making use of the same facial technology.

Fig 1.14: Security [4]

- **SURVEILLANCE in LAW ENFORCEMENT [1,4]**

Very Advanced video surveillance in case of ATM Machines, or so as to control the Traffic. Using the facial recognition the images or the faces from the camera are used for the enhancement of the CCTV images received and Investigation of suspect also requires such techniques.

Fig1.15: Surveillance [2]

- **FACE ID [6] –**

One Plus, Samsung, Oppo and so on, the latest devices come equipped with the face unlock which was initially introduced by Apple popularly known as the “Face ID“. Sensors are integrated in face ids that consists of parts of which include two types of modules i.e. the Romeo and the Juliet Module respectively. The former part i.e. the Romeo Module projects nearly sixty grand (60,000) dots on your face or the particular user using face unlocks and the other module which is the Juliet Module is actually used to read and find if any particular pattern esists and this pattern then stored in-to devices CPU is used to confirm the face match with the device owner or user’s face.

Fig 1.16: Face Id [2]

1.4 DEEP LEARNING

Deep learning, a ML technique that is used to teach computers so that they learn something humans have naturally i.e. learn by example. A key technology behind driverless cars, which enables to identify the different signs one case being distinguishing a pedestrian from nearby pole.

The key or the secret to the voice controlled consumer devices that include smart-phones, tablets, IPADs, TVs, and portable speakers which are hands free. Like ML, Deep learning has also been hot topic in technology.

Recent times have shown results which earlier seemed impossible. In deep learning, M.L. model that studies itself so as accomplish at hand tasks which involves classification directly from text, maybe images or sound too. The term state of the art in case of accuracy can be achieved via Deep learning models and the performance may even tend to exceed humans. The training of models is done via using of large dataset which includes labelled data and also includes neural network which contain n-number of layers.

Defining the term deep learning has been one challenge for many people because it has noticeably changed several forms slowly over the past decade. One closest and he most useful definition that can be used to specify the concept of deep learning applies with the "neural network consisting of at least two layers."

The above definition has a problematic aspect because the deep learning sounds as if this concept has been nearby since the 1980s. But we feel that "neural networks" had to come or transcend architecturally from network styles similar to something that was early in its times (i.e. in conjunction with lots and lots of processing power) instead of showing spectacular results noticeably seen in recent years.

Following are lists of some of the facets in the evolution of the term neural networks:

- Previous networks consists of more neurons
- Connecting layers/neurons when defining a neural network is more complex ways
- The training amount and computing power available in excess

• Automatic feature extraction

Visualising the context of deep learning, the figure below depicts the formation of relationship between AI, next is ML, and finally deep learning.

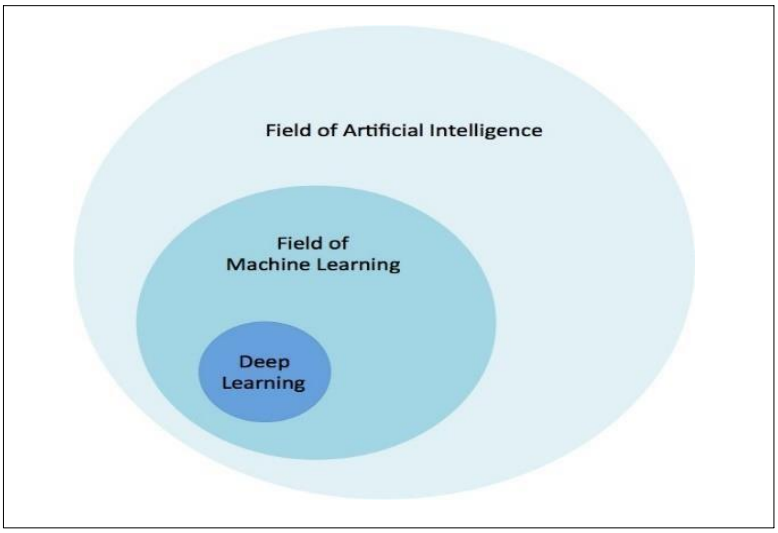

Fig 1.17: Subset [2]

The recent techniques of deep learning have proven to be lead to so much powerful discoveries such as Google getting into quantum images in seconds which would without it take years. The accuracy in with the help of deep learning is one of the main reasons why the top flight accuracy can be noticed in the machine learning modelling, alongside this it also depicts generative mechanics which has fascinated even the scientists who are not from the computer background. Example of the above statement, the art generation demonstrating for which neural network using deep learning has been trained on one of the familiar painter's works, and as a result the network rendered other photographs but followed the painter's unique style.

The above results in several philosophical discussions, and this includes , “can machines be creative?” and then “what is creativity?” These questions have left many pondering at. ML has evolved over several years, similar to something like seasons that change: subtle but steady and then you just wake up 1 day and realise that the machine has become the undefeated champion on JEOPARDY or QUIZ Master.

Machines being more intelligent and then taking on humans in the field of intelligence? AI being more powerful and how that could happen? These are just a couple of questions that have not been answered and need to be answered at the earliest.

1.4.1 Importance of Deep Learning

Accuracy matters and results how accurate the algorithm you used is. Deep learning today has succeeded in recognition and attaining accuracy at levels higher than others which remains higher than ever. So the impact of this is that it helps consumer electronics meet the expectations of users, and becomes very central for safety critical applications which include Teslas-automated cars. Latest advancements in this field of deep learning continue to improve and have improved to a point where DNN or deep learning has now even started to outperform the humans in some tasks one such task example is- Google Lens which classifies images as objects.

The major reasons deep learning so recently became useful instead of the 1980s:

1. The amount of **labelled data required by deep learning is very high**. Take a case which includes the automated car (like Tesla) development that requires millions and millions of dataset of images as input along with countless of hours of video.

2. Deep learning today requires substantial **computing power**s and to triumph that high-performance GPUs are needed as they have a parallel architecture which is efficient for the deep learning and this forms another major reason.
   When it is combined with clusters or even in cases such as cloud computing, this

helps the R&D taskforce or teams to reduce the time needed for training of model , deep learning network and maybe even reduced from weeks to hours or maybe even less.

1.5 FUNDAMENTAL STEPS OF FACE RECOGNITION:

The stages that are indispensable [7] and obligatory very important so as to design such a system that can be used to identify such face images from the provided dataset that not only contains the face but also the non-face images present in the least time possible time and also with the most possible accuracy rates which are high in number.

- **Capturing Images [7]**

The very first step involves generally collecting or capturing the sample images and that too in case of a well- known and suited conditions and the work that is to be carried out is generally done during the very beginning or the start of the recognition process of the face.

- **Extraction of the Features of the Face [7]**

After the first step in which the data was collected then in the next step this collected data is used to process the facial recognition, facial features that have been or can be extracted from the various images that the user has in the user created database so as to designate some kind of template.

- **Contrast of the Extracted Features with the Existing image [7]**

After facial recognition has been done which is second in order, the data or features collected are to be compared with templates that pre-exist.

- **Equivalent Features (Matching) [7]**

The face features extracted in the last step need to be matched and verified so that some kind of decision can be made w.r.t. the pre existing images present in the database.

1.6 PROBLEM DEFINITION

The different technologies mentioned in the above are meant to suggest that with their help we aim to identify genders with help of different facial features and using different algorithms the task we wish to achieve is quicker than the humans and also further the future scope of this is implementing the neural networks in the real time to identify the genders. The scope is not only limited to this as monitoring or using in surveillances

Face biometrics are just one kind of biometric while there are several other biometrics out in the society but still the face based biometric becomes undoubtedly best when the task at hand is to identify or provide help with an ongoing investigation against the criminals or culprits. The design of the system is such that it could recognize anyone just by the image of the persons face effectively from the dataset that has been provided in all robust conditions with best accuracy and least time possible.

1.7 ORGANISATIONS

The components that you will come across while going through this report mainly include-

Chapter 1 provides a basic introduction about the project so as to give the basic idea and details regarding what we are going to do and also to familiarize you with the technical and few of the necessary theoretical aspects.

Chapter 2 includes the Literature survey i.e. review from different journals, research papers etc.

Chapter 3 aims at the system design, the techniques and the different tools needed for the project.

Chapter 4 provides the conclusion, and also tells about scopes in the future for the same.

CHAPTER-2

LITERATURE SURVEY

Literature Survey or Literature Review as the name suggests the Chapter is based on analysing and engaging in thorough study of different sets of theoretical works that have been published before and are available for the reference purpose beforehand.

The literature survey is much needed because what it basically does is that it compares different sets of pieces or the theories that have been published worldwide or have been established, these theories can vary from different topics to just one particular topic, and that topic is usually from a very specific area of research that could have been possible lasted from years to months period, and during these researches the different kinds of experiments that are performed or are being carried out or conducted so as to establish something different than that has already been achieved and published till date.

And with the help of this, any person who wants to proceed in the research field and work will lookup for the available resources and try to understand them. Now, the benefits that are associated are that it can provide you a particular direction you need to look at and also help you with shortcomings of various methods which have been provided and used by all sorts of researchers or people from certain part of study.

2.1 RELATED WORK

Xue Li [8]one of the researcher in a paper proposed such a method which aimed to highlight and provide an outcome to the issues or the difficulties that they faced during the research which was that it could be faced during trying to get or detect an individual's eyes and to overcome this the method that was proposed used non- intrusive approach.

Grey-scale transformation was a type of pre-processing that was done initially. The method that was applied was- Adaptive boosting algorithm [8] and this algorithm is ordinarily used to eradicate whatever features irrelevant could have been detected while trying to detect the face and they may not be that important, next step was using the

different connected components method and eyes were located with the best accuracy using this specific method and the status of eyes could be examined with its help.

The following stages depict what different stages were proposed:

a) Input Image

b) The Recognition and Detection of Face

- Adaptive boosting Algorithm
- Detecting human face

c) Detection of eyes along with their position

The human face susbjected to different testing conditions which were subjected to varying conditions. The images that have been shown below depict the conditions, the thing that needs to be noticed here is that the result remained consistent even under different conditions.

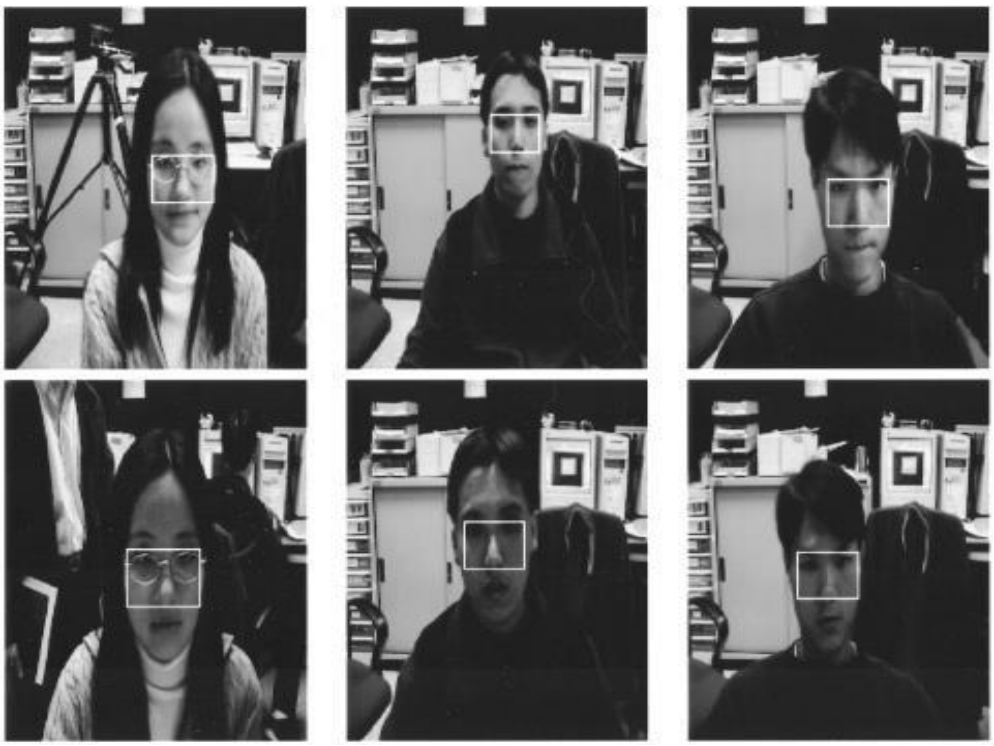

Fig 2.1: Detect faces under different conditions [8]

The method that was talk about earlier consisted of the training set that used a sample database and that database consisted of 500 images to the count. The accuracy is a game changer in selecting a method and this method's accuracy which involved detecting the eyes and locating its position came out to be nearby 98% and nearby 94% respectively.

One of the conclusion that could be made from the initial experimental results that was conducted on this training set provided that the method or approach was displaying good robustness and improvement in accuracy could be noticed [8].

Wenchao Zhang [10] suggested an algorithm as a permutation of two operators defined LBP [10, 17] and second one is the Gabor Wavelets. Initial or the works that were done at a very earlier stage on face recognition would usually be based on the method that applied fisher-faces [12] along with Eigen-faces [11]. Making use of facial features meant that it was being referred as a use of facial points that were being treated as features, indicators or descriptors which varied for different humans and their facial expressions. Generally those methods that are Feature based [12]are seen showing properties between facial features and these features include jaw line, chin, eyes, mouth, nose etc. Plenty algorithms are present but then to perform the technique of recognition of humanface not many algorithms have a great accuracy and thus making it not acceptable enough and this is because due to the factor that causes variations due to a person's process of aging along with several additional factors in these images of humans and instead of class variations that can occur due to likeness between individuals and instead these inconsistencies can range from being limited to overall and this refers to wrinkles looking noticeable on a person's face at some place like cheek or around mouth.

Table 2.1: LGBP and KLD-LGBP recognition rate

Approaches	Session-1		Session-2	
	Sunglass	Scarf	Sunglass	Scarf
LGBP	0.800	0.980	0.620	0.960
KLD-LGBP	0.840	1.000	0.800	0.960

Reference to these values- paper [10]

The above table clearly depicts that the recognition rates in case of KLD – LGBP prove to be more accurate when compared with LGBP.

At the early stages while performing face recognition the techniques would generally focus only on frontal view of human faces (images) and also able to detect single face instead of multiple faces. Nonetheless, how to identify a face in different view i.e. view other than person's frontal view still poses as a challenging factor. With the help of traditional methods to some extent good results in case of view of images that show front side of human face or images consisting of single view could be observed.

Procedure that utilized the concept of PCA, the full form of which is Principal Component Analysis [11] and this algorithm will eliminate those features that are not helpful or relevant when it comes to the recognition of faces. The algorithm propsed above was designed so that one could identify same face and that too from different kinds of views.

To understand this the model of Eigen Vectors (11, 12) & Eigen values (11, 12) required to be presented so that one could understand or identify the variation in these images because every single Eigen vector has an associated eigenvalues with it and the Eigen vector that can be seen having a greater eigenvalues depicts that it can provide you with additional statistics when considering these images variation when equated with those Eigen vectors which have a relatively lower eigenvalues [11].

$$\mathbf{AX = \lambda X}$$

In the above equation,

A- Vector Function

Lambda- Eigenvalue and

X- Eigen vector.

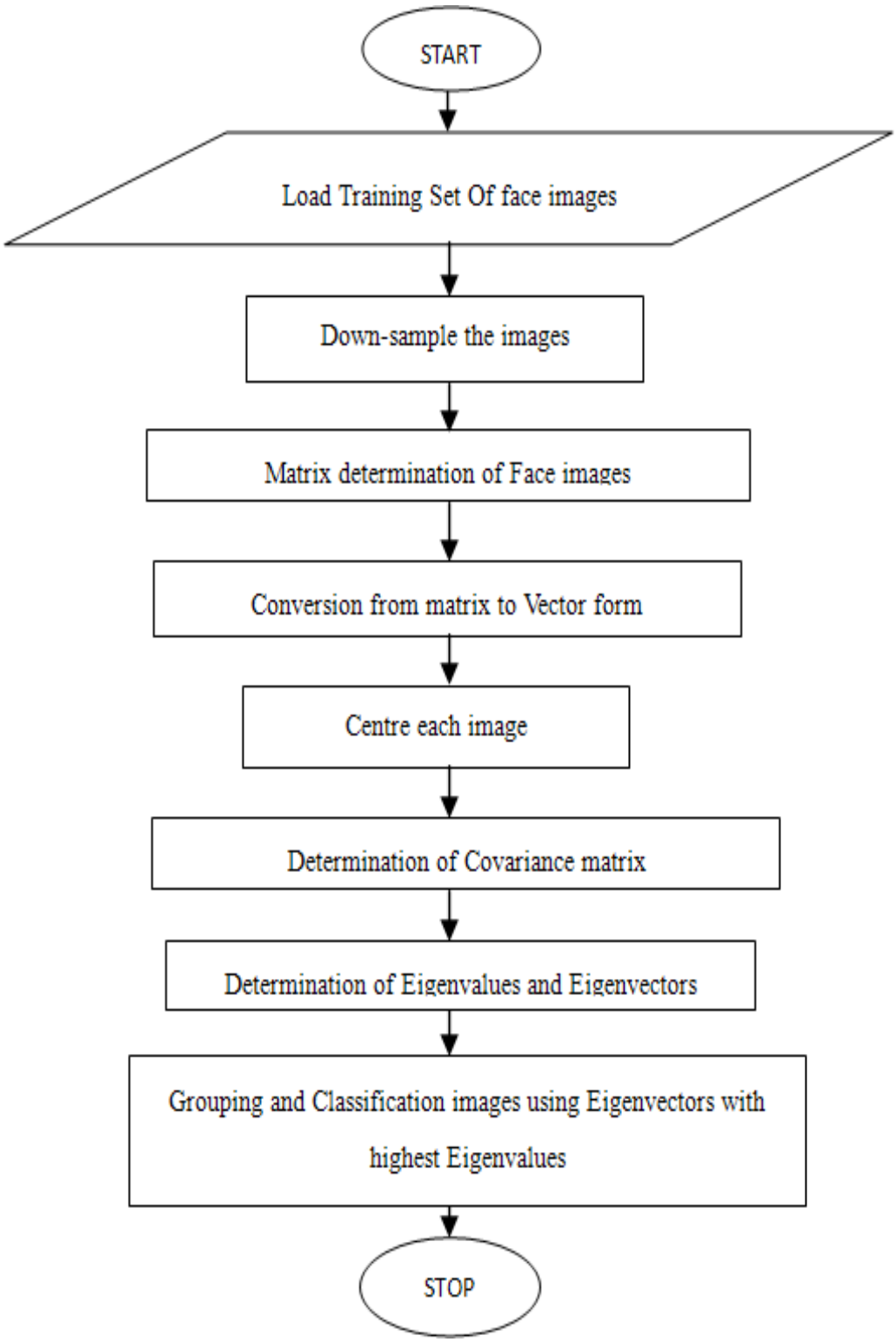

Fig 2.2: Flow chart of eigenface [12]

The testing dataset that was used consisted of 500 images of different humans or individuals and these images were used to check how the algorithm worked and the system designed identified almost 485 humans or faces and these identified images are equivalent to an accuracy of 95 % which at intial stages is very good but however this designed system failed when dealing with an occluded face or an image that was unclear.

Table 2.2: Recognition of Faces Using Eigen-faces Algorithm

Overall Images	Successful recognition	Success Rate
500	585	96%

Reference to the values to paper- [11]

The research paper that has been taken up as a reference the model that was suggested in past making use of face recognition with the help of Eigen faces (11).The job of reducing any un- relevant or features that can be avoided as they are not important posed a major problem during face recognition. The PCA was used while performing the face recognition and this was achieved with the help of EigenFaces [11] which basically aimed at eliminating or removing any or all of those features that were not necessary and made them unwanted and as a result the image that was obtained after applying the above process of elimination of such unwanted features resulted in Eigenfaces which had a associated Eigen-vector and this Eigenvector had its corresponding eigenvalues. As discussed earlier, the Eigenvector that has a maximum Eigenvalue would give more accurate and best information about the variation that was seen in these images.

Even there were such cases when PCA that was being used to overcome the features problem failed to yield desirable or expected results and this lead to a new theory being proposed and put forward. The theory that was proposed made use of LDA alongside PCA.

The proposed algorithm i.e. LDA can be used to find out the subspace in the set of images that has been provided by the dataset, the vectors that so resulted which were used to define that particular space were called as Fisher faces [12].

In case of face recognition making the use of fisher faces [12], the steps that need to be followed include:

- Design System- The system so designed, usually intended or recruited in such a way that it studies the images by cross-examining those images that were gathered as for the results and obtained after using the removal feature in ase of these images.

- IP or Image Processing Process[1]

  The processes included in IP -

  1. Process to retrieve the data
  2. Process to image processing
  3. Process to generate feature

Recognizing a face which is done with help of this system [3] that made use of this algorithm which was able to distinguish the human faces from the pictures with an accuracy of around 93% from which it can be inferred that for every 100 images 93 images were recognised accurately and the plus point about using such a system design is that it is also immune to blurred or buzz or even the clamoured images but still one difficulty with the following algorithm could be noticed as a problem whenever there was a case of partial occlusion arised. Apart from this, when a particular individual clicked images in poses which were not similar a problem would arise.

Chen Dong [13] to detect the users face planned or propsed such a color model and radial utility networks and used them to study and validate the each and every human individuals face while doing detection of face, after this in case of proposed work he made use of projection which was integral and Hough round Transform

[13] and this was aimed to detect the eyes of an individual. The method comes with principally two positives or profits,the main being making the use of important projection

function and to achieve it we can use boorish and rude positioning when it comes to the eyes of humans or an individual and then integrating it with Hough round Transform which aims at determining the location of a persons eyes with the best correctness.

When using this technique, another benefit that results in defining the eyes precisely because the human eye when observed is done complete as a pair, and this is done because it may detect eye of the human in the least possible time and thereby this results in improving the accuracy as the chances of wrong outputs being detected are highly reduced.

Making use of this algorithm comes associated with that is that it works really well and upto the mark during recognition of the face done in case of the frontal faces but this algorithm wasn't accurate enough when it came to the images being occluded.
After giving the research paper a thorough read the conclusion that we made and came across was that the algorithm that was being used in the implementation has been depicted by the help of the flow char that has been provided below:

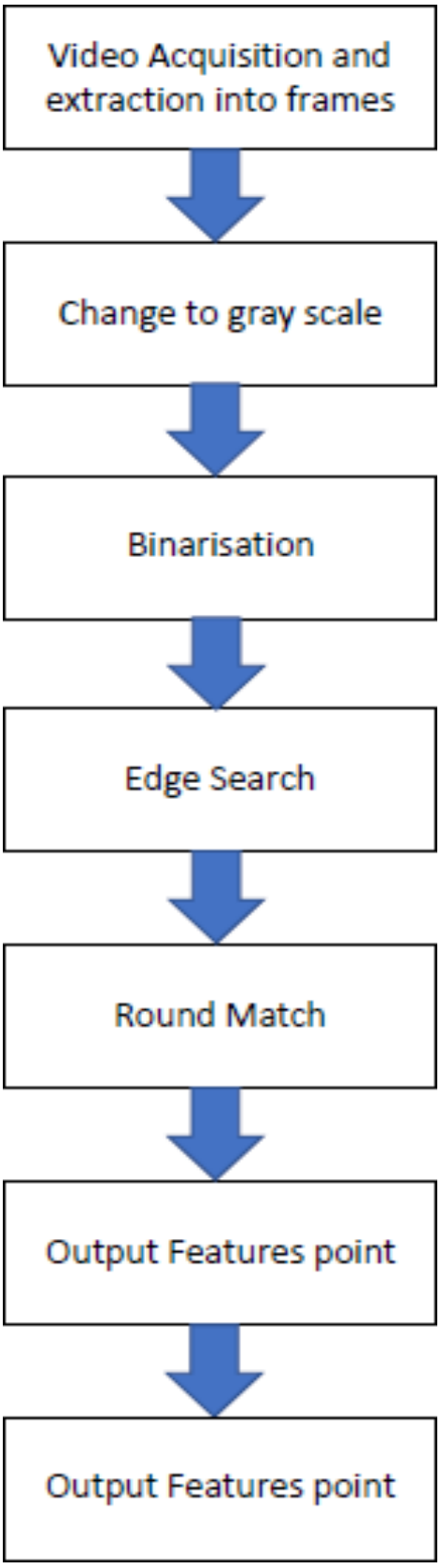

Fig 2.3: EigenFace [31] flowchart

The conclusion included this methods basically two leads or benefits and they are important for improvement scope and accuracy

To recap this, the first included making the use of an integral projection function that aimed at achieving boorish or rude positioning when it came to the human eyes and following this its integration with Hough round Transform so as to find out with exat accuracy where the eyes were located in an individual.

The video that is made and captured is pre-processed. After the pre-processing has been done, the face area needs to detected in the next step achieved with the help of the neural network. After the face has been identified, further the Important projection technique can be applied which helps to find the exact or the accurate eyes location of the individual which can be noticed in the image below. Finally at the last, the Hough transform(14) technique is applied with the aim to spot what is the state of the eyes.

Fig 2.4: Detection of eye states

Talking about the results, they were good enough when obtained while testing of images which were still, when it came to people with spectacles or glasses even then and positioning speed was really fast as the time taken was mere in milliseconds.

CHAPTER- 3

SYSTEM DESIGN

This chapter discusses the means that one needs to make use while developing the framework. Following to experiencing distinctive research or study papers planned to go for a non intrusive way for developing my framework. We all are familiar and know there are loads and loads of different face detection and acknowledgment strategies are accessible but you should go for the information centered measures for designing our structure and such a strategy is needed because this way is progressively compact and appropriate under numerous environments.

A system dependent on following two stages is designed:

(a) Face Detection

(b) Face Recognition

A way of distinguishing faces from list of appearances and non-faces or other items is known as face detection. The innovation of face detection has been utilized in different parts and mixture of practices that spotted a human face in computerized images/pictures. While developing the face detection structure, remove the noteworthy highlights from the face of human and collect values in Python's NumPy array. To extract features from human face different kind of techniques are available and have been listed below.

3.1 FEATURE EXTRACTION TECHNIQUES

While extraction of feature from face the procedure to be applied, the camera at first must detect the human face and from that a image then only the face is trimmed from the captured image frame or from the current frame displaying so that the handling of the background got reduced and we got the effective and efficient and better results.

At present the feature extraction of an image from face, there exists limited strategies that maybe used namely skin shading technique, template matching technique, feature based technique, and knowledge based technique and so forth.

In case of the Skin shading detection strategy, one of the mostly used tactics as this strategy exhibits to be firm in the detection to be made for human face. This specific technique makes each pixel that are present in skin shading have been identified and subsequently exploiting data that fits out to be peaceful simple finding the shards of the image outline in which around a face or people may be present explicitly.

In the Feature based skill in reality identifies human face dependent as per the acknowledgment of highlights which might be merely human alike such as eyes, nose, lips, mouth and after that model is prepared and dependent on the inter support of such highlights, the nearness of a face is followed which forms the framework which distinguishes whether face is human and available or not.

The Knowledge based techniques are principally the customary based approaches or strategies. The data provided that pre-exists in the database, the criteria is being derived and subsequently the finding the human face is prepared. At this point the countless features are observed basis being their positions relative to each other.

In any case, this procedure is admired but this is not so simple as it may look as countless conditions in case of the face might make problem to get the rigorous conclusions that is there may possibly be such an instance where eyes for specific face might be closed or shut, unambiguous human is wearing dark glasses could be possibility, in such secnarios it might resultin giving wrong conclusions.

In the Template matching technique have need of the measurements for the face viable in numerous stances and subsequently contrasting them with the forthcoming info pictures. Any place a match is made, derivations are drawn. In any case, this technique likewise will in general be somewhat difficult as the image for contrasting need to be stored and afterward utilized that data whenever needed.

We picked Knowledge based technique for extracting features of a face since it is regarded as the most reasonable and dependable technique in face detection.

3.2 ALGORITHM FOR FACE DETECTION: EIGEN FACE

The term given to the set of eigenvectors when they are developed in the computer vision matter of human face acknowledgement is known as Eigen faces. A procedure of developing eigenfaces for recognizing the human face has been formed by Sirovich and Kirby (1987) and exploited by Matthew Turk along with Alex Pentland in detecting or classifying the face. The eigenvectors are derived mathematically from the covariance matrix of the probabilistic distribution over the high dimensional vector space of face images. The eigenfaces themselves form a stricture set of all pictures that have been used to develop the covariance matrix. The previous steps results in dimensionality reduction by clearing the tinier set of root pictures to symbolize taught data set of the facial images.

3.2.1 Feature Extraction

To extract the features from the procedures to be applied, the human face needs to be detected at first and can be detected viz. the camera or from an input image then only the face is trimmed from the apprehended image setting or from the existing setting exhibiting so that the processing of the background got reduced and we got the efficient and better results.

Eigenfaces algorithm is robust in detection of face. Basically eigenface algorithm works on the eigenvactors to detect the face.

Next phase to make set of eigenfaces, follow the procedure listed below:

1. Facial images of human dataset needs to be made by collecting the desired images. Desired conditions include enough lighting or bright conditions, and needs to be normalized so as to have the eyes and mouths in tune with images in the dataset. Resampling the image for the pixel resolution such as: (r × c). A single vector is for every image.

   All the images in the training dataset have been stored in solitary matrix T, so as each column in this matrix represents an image.
2. The mean needs to be subtracted. The Find the average of picture and later on this needs to be subtracted from each and every original image in T matrix.

3. Let S be covariance matrix and the eigenvectors and eigenvalues are calculated of the same. Each eigenvector consists of alike dimensionality i.e the segments count as the pictures in actual, also along these lines anyone could themselves be able to see the image as a picture. The eigenvectors for this particular covariance lattice are represented along these lines termed as eigenfaces.
4. The principle components are next take in consideration. In case of the descending order eigenvalues need to be sorted and eigenvectors need to be arranged accordingly.

   The quantity of head parts k is resolved discretionarily by setting a limit ε on the total variance.

   Total variance v = (λ_1+ λ_2+…+ λ_n), n represents elements count.
5. Smallest number k that satisfy the equation ((λ_1+ λ_2+…+ λ_k)/v) > €.

The eigenfaces now calculated can be used to utilize for representing mutually present and fresh facial images: new input can be taken which are mean-subtracted images.
In this particular manner we can record how when a new face is different from mean face that has been already calculated. The eigenvalues that are linked with every single eigenface depict how pictures present in the training dataset vary when compared with mean picture along that path. When eigenvectors subset are projected for a picture the data tends to be lost but these losses can be limited by keeping those eigenfaces who have the biggest eigenvalues. Consider a case where a 1000 × 1000 picture will create 1000000 eigenvectors. Applications which are pragmatic in nature, can commonly distinguish these faces as they make use of a estimate on somewhere around the range of 100 to 150 eigenfaces, to achieve the goal where 1000000 eigenvectors maybe discarded.

3.2.1.1 Computation of Eigenvectors

PCA is performed rightfully on the covariance matrix created for use of pictures can be computationally infeasible. Events where little pictures are being utilized, say 100 × 100 pixels, a point is ceated over 10000 D space for each image and the covariance matrix S which is the framework of 10000×10000 = 108 components. The position of the

covariance matrix has been constrained by the magnitude of training simulations: Supose N training models are present, N − 1 will be the number of eigenvectors that have at most with eigenvalues as non-zero. But to the contrary, chances for the size of these training models seem to be smaller when compared with pictures dimensionality,however the principle components can still be disclosed wholly the extra efficiently as shadows.

The pre-processed matrix for repective training models is assumed as T, such as each and every segment comprises of 1 mean subtracted picture.

$S = TT^T$ represents the calculation for covariance matrix

$Sv_i = TT^T V_i = \lambda_i v_i$ represents eigenvectors disintegration of S

Though TT^T is a very massive matrix, and instead we consider,

$T^T T u_i = \lambda_i u_i$ which is the eigenvalue deterioration

When pre-multiplying is done on both sides of the equation with T, the result is:

$TT^T T u_i = \lambda_i T u_i$

Inferring that, when u_i is an eigenvector for $T^T T$, at that very point $v_i = Tu_i$ forms eigenvector for S. Consider a training dataset of 400 pictures that consist of 100 × 100 pixels, the matrix $T^T T$ is a 400 × 400 matrix, more reliable and easier to manage significantly than the 10,000 × 10,000 covariance matrix.

Notice anyhow the following vectors v_i aren't normalized; if you wish to do normalization then it needs to be done as an additional progression.

3.2.1.2 Connection with SVD

Let X be a matrix of d*n dimensions with column x_i as a image vector with mean subtracted.

Then,

Covariance(X) = $(XX^T)/n$

Let SVD of X be:

$X = U\sum V^T$

Then the decomposed eigenvalues of XX^T is:

$XX^T = U\sum\sum^T U^T = U\Lambda U^T$, where Λ = eigenvalues of XX^T

Thus,

The eigenfaces = initial k(k<=n) columns of U related with non-zero singular values.

XX = 1/n is the i^{th} eigenvalue.

Using SVD on information matrix X, worthless to compute the real covariance matrix to get eigenfaces.

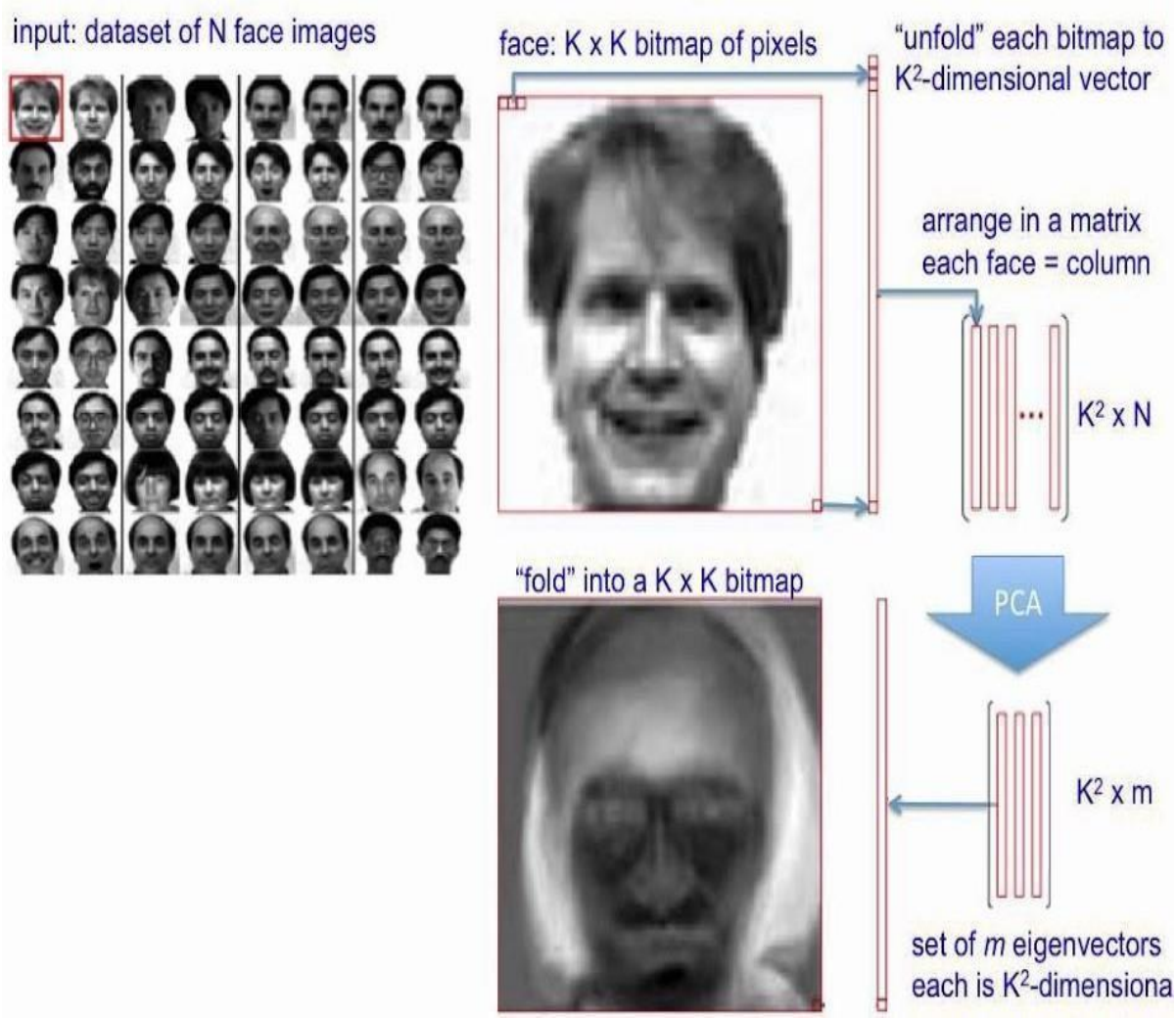

Fig 3.1: Eigen Faces [12]

The whole procedure which we pursued while utilizing a eigenfaces has been discussed above and the procedures have been appeared in the flowchart underneath i.e fig 3.2.

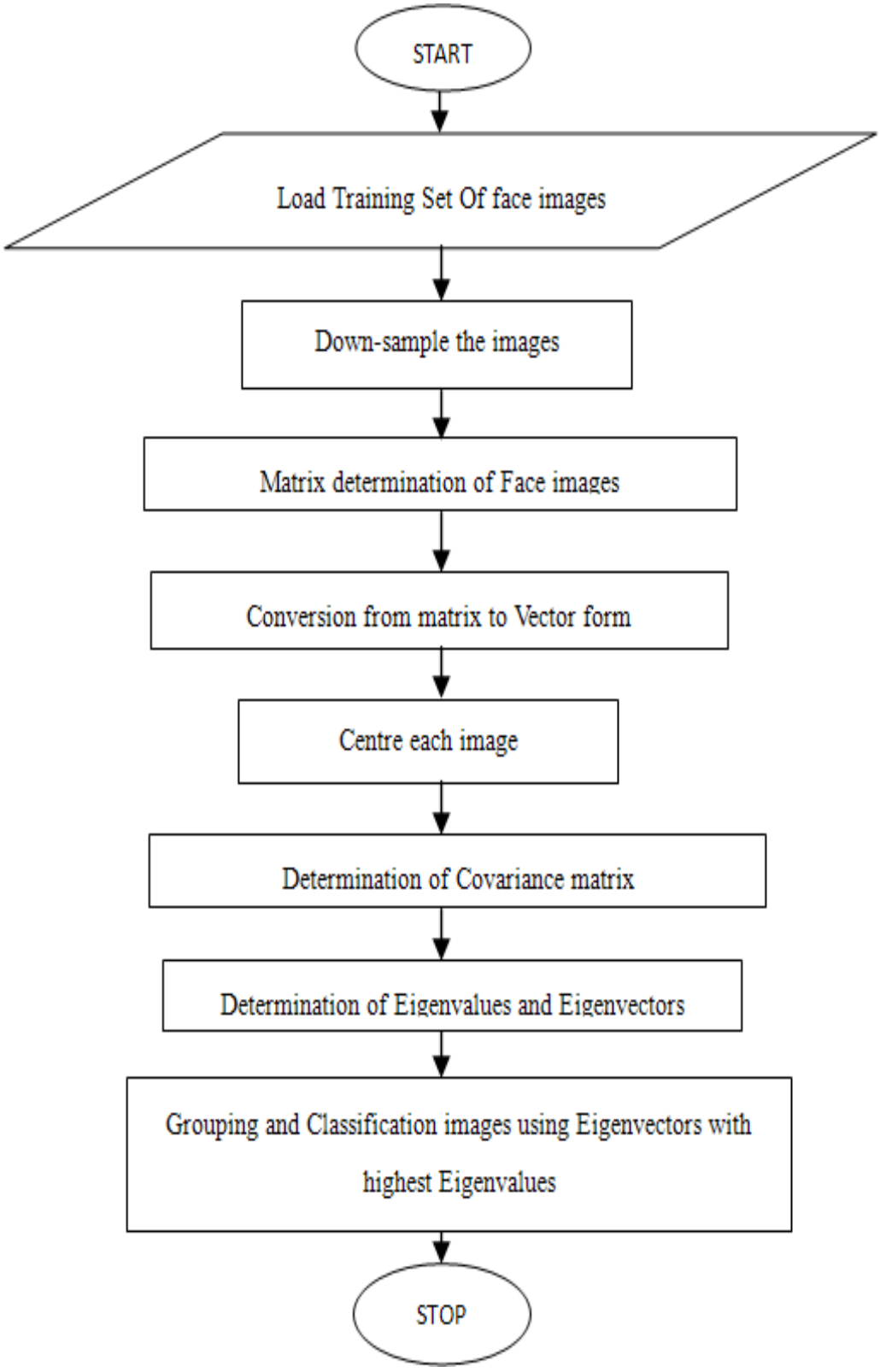

Fig 3.2: Flowchart of Eigenface Algorithm

3.3 SYSTEM FOR FACE RECOGNITION

Gender plays a significant role in somebody's distinguishing proof. Programmed gender classification has gotten significant to an expanding measure of utilizations, especially since the ascent of social platform and social media. Concealing genuine estimations of these factors can cause for security issues for the most part. Now by using face recognition technique it is easy to classify the gender over any platform.

Different algorithms for developing the system were used for the same reason and later a comparison of those algorithms that make recognition of gender with input images and real-time.

3.3.1 Algorithms Used

1. KNN Algorithm

K-Nearest Neighbour (KNN) is an algorithm in machine learning which fundamentally makes calculation based on former data issue or accessible. In this algorithm the framework is trained by giving images of various people and afterward the fresh picture is predicted by the framework basis being the past data.

In KNN, K is the number of closest neighbours. Number of neighbours in KNN is the central deciding factor. K is commonly an odd number if the number of classes is 2. Assuming point P1, for which name needs to predict. To start with, you locate the one nearest point to P1 and afterward the name of the closest direct doled out toward P1.

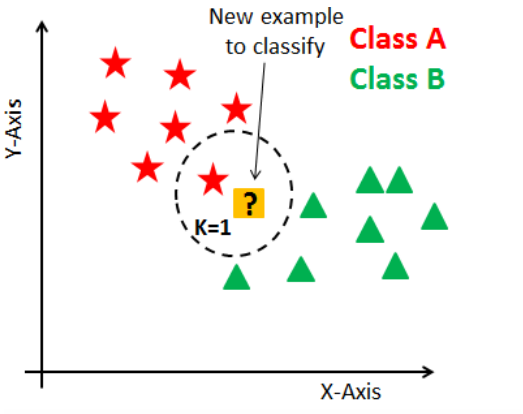

Fig 3.3: Classification of new input

Assume point P1 and we needs to predict under which label it lie. To start with, you discover the k nearest point to P1 and afterward classify the points by large number of vote of its k neighbour's. Each element votes in favour of their group/class and the group/class with the most votes is selected as a prediction. For finding nearest similar point, you discover the separation between points utilizing separation estimates, for example, Euclidean separation ($\square = (\sum_{\square=1}^{\square}(\square_{\square} + \square_{\square})^2)^{1/2}$), Hamming separation ($\square = \sum_{\square=1}^{\square}|(\square_{\square} + \square_{\square})|$), Manhattan separation ($\square = \sum_{\square=1}^{\square}|(\square_{\square} + \square_{\square})|$) and Minkowski separation ($\square = (\sum_{\square=1}^{\square}(|\square_{\square} + \square_{\square}|)^q)^{1/q}$). KNN has the accompanying essential steps:

1. Calculate separation

2. Find nearest neighbours

3. Vote for labels

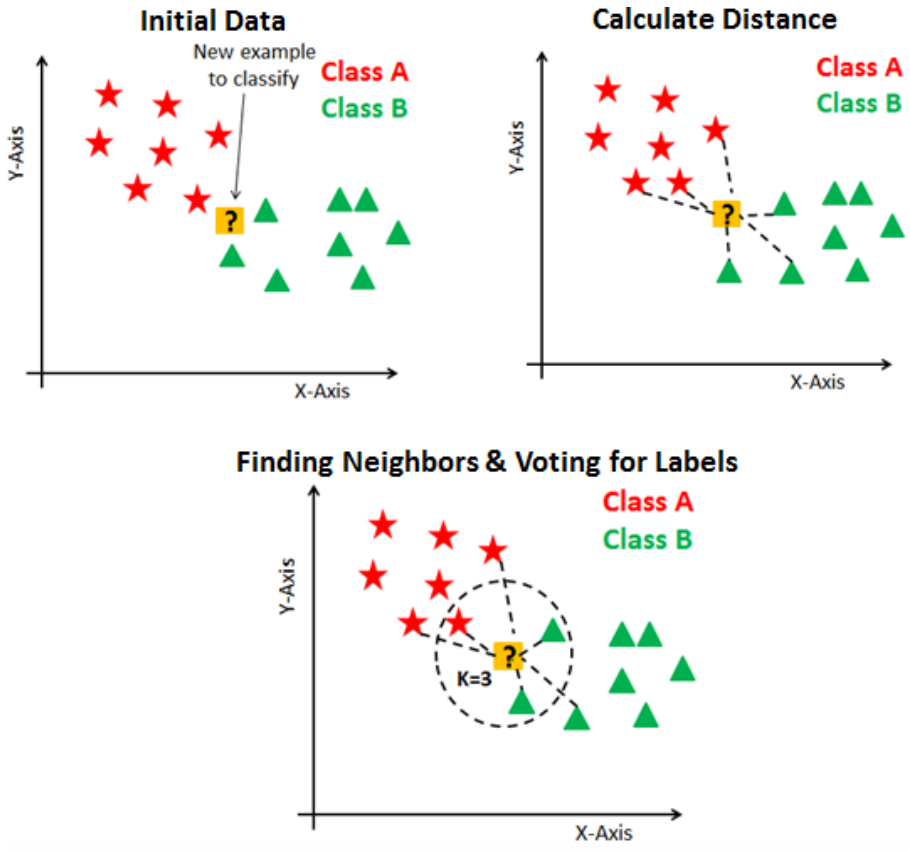

Fig 3.4: KNN algorithm

2. Logistic Regression Algorithm

Logistic regression is very frequently used machine learning algorithm and is a beneficial regression technique for solving the problems which have been classified as binary. For several classification problems Logistic regression algorithm is used such as spam detection, Gender prediction, Diabetes prediction, etc.

L.R., a factual procedure designed for predicting two classes. The target or result variable environment is dichotomous. The term "Dichotomous" means there are just 2 possible classes. Likewise, as in gender classification project which is aimed at predicting whether the image of human given as input is male or female.

It is an unusual illustration of linear regression where the objective variable is categorical in environment. The variable(objective) utilizes log of probabilities as the dependent variable. Logistic regression guesses the chances of result of a similar case using a logit function.

Linear Regression Equation:

$Y = \beta_0+\beta_1X_1+\beta_2X_2+\ldots+\beta_nX_n$

Where, X_1, X_2 ... and X_n represent explanatory variables and Y is dependent

variable. Sigmoid Function:

$p = 1/(1+e^{-y})$

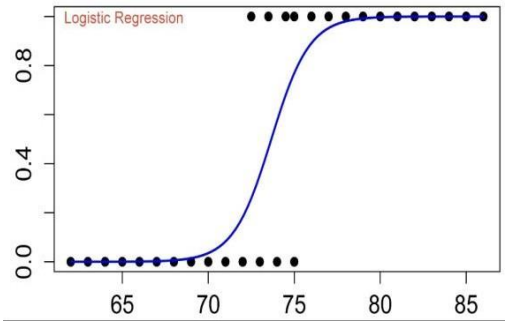

Fig 3.5: Sigmoid Function

Applying Sigmoid function on linear regression:

$$p = 1/(1+e^{-(\beta + \beta X + \beta X + \ldots + \beta X)})$$

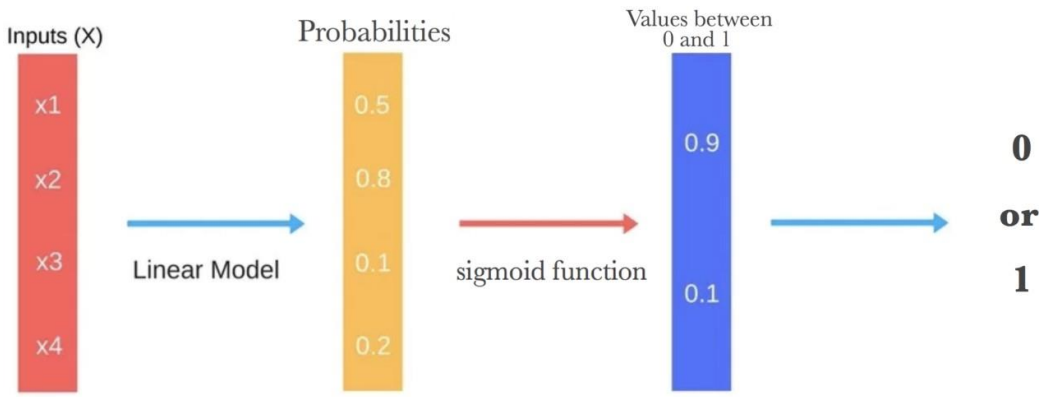

Fig 3.6: Logistic Regression Algorithm

3. Convolutional Neural Networks (CNN)

For the real time human gender detection or recognition earlier we used OpenCVs fisherfaces eigen-vectors implementation. The following approach in line was method that two researchers from Israel introduced, Gil Levi and Tal Hassner back in 2015. For reference the CNN models trained respectively by them have been tried to implement in this project. Python (PIP) has an in-built library OpenCV's which consists of a package named dnn i.e. "Deep Neural Networks".

The following “DNN” package used from OpenCV consists of a class known as Net which is basically used so as to populate a neural network.

The project has used some in-built libraries and packages that support neural network models from deep learning frameworks which are well known- caffe, tensorflow and HaarCascades. The researchers previously mentioned published their work on CNN models as caffe models.

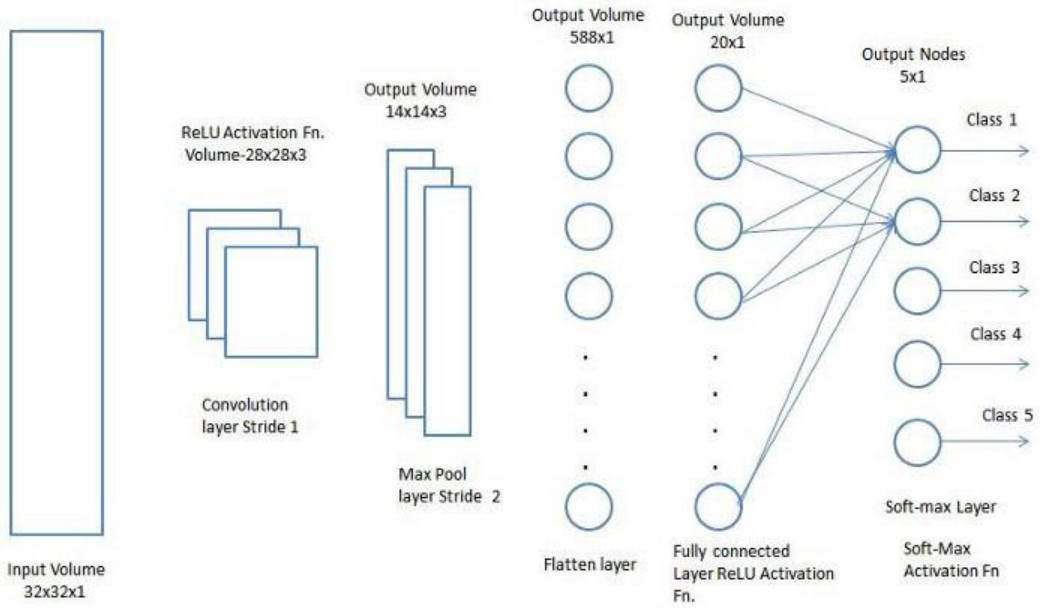

Fig 3.7: CNN Architecture

4. Python in-built Libraries used:

Several in built python libraries were used while implementing the project namely- pip, matplotlib, keras, tensorflow, pandas, pillow etc.

3.4 TEST PLAN

The particular section exhibits the carrying out subtleties for framework that has been proposed and made so as to classify the gender. While executing our framework, the software adaptations, bundles and so on have been described in detail below:

3.4.1 Requirements:

Platform(OS):
MacOs 10 or above
WindowsOS 7/8/10 or above

Software Used:
Anaconda Navigator/ Conda Prompt/ Python IDLE 3.0+/ Spyder

Version:
3.7.0 or above

Minimum Graphic Requirements:
1. 1 MP Camera
2. Graphics Card- Intel /NVIDIA / AMD

3.4.2 Implementation Details:

The process of implementing is done over 5 phases:

1. **IMAGE as INPUT:**
   The first phase is where we provide different images to the system in numerous alignments with different brightness i.e. lightening conditions and make use of these input images as a training dataset for the system hence the structure is able to make a difference if the being in the image is manly or womanly.
2. **FEATURE DETECTION:**
   In this stage i.e second stage we use the eigenface algorithm to detect the face in the photo and afterwords extract the features to train the model
3. **KNN ALGORITHM:**
   Ths stage three makes use of KNN algorithm so as to develop the system that recognizes and in this system it makes use of the hypothesis of Euclidean distance i.e. we find out wha the Euclidean distance for the new data point is w.r.t. to all its neighbours.
4. **LOGISTIC REGRESSION ALGORITHM:**
   In this stage we use the idea of logistic regression as it is the algorithm which only provide two output. We use the concept of sigmoid function to differentiate between male and female.

5. **CNN Architecture:**

   In this stage we use the idea of real-time gender detection using integrated webcam to give the machine learning model/algorithm the input and as per the model output is display on the webcam interface using tensorflow, keras etc.

3.5 CONCLUSION

Proposed framework has been examined in this very particular chapter in depth and also how the facial recogonisation system can be executed. Similarly we discussed about several kinds of the algorithms being implemented in numerous phases while doing face recognition and also the very means which will be pursued while constructing our framework.

CHAPTER- 4

PERFORMANCE ANALYSIS

4.1 Pre-Processing Image Analysis

```
# default format can be changed as needed
def createFileList(myDir, format='.jpg'):
    fileList = []
    print(myDir)
    for root, dirs, files in os.walk(myDir, topdown=False):
        for name in files:
            if name.endswith(format):
                fullName = os.path.join(root, name)
                fileList.append(fullName)
    return fileList
```

Fig 4.1- Image Settings

In figure 4.1, the directory is processed fir the images which contain the format jpg and then they are added to a list which consists of all images that satisfy the condition and then this list is appended to the path.

```
# Make image Greyscale
img_grey = img_file.convert('L')
#img_grey.save('result.png')
#img_grey.show()

# Save Greyscale values
value = np.asarray(img_grey.getdata(), dtype=np.int).reshape((img_grey.size[1], img_grey.size[0]))
value = value.flatten()
print(value)
with open("imageData.csv", 'a') as f:
    writer = csv.writer(f)
    writer.writerow(value)
```

Fig 4.2-Greyscale Conversion

In figure 4.2, the images are converted to greyscales and use numpy pandas method of arrays stored and several parameters are passed to the table given below in fig4.4 .

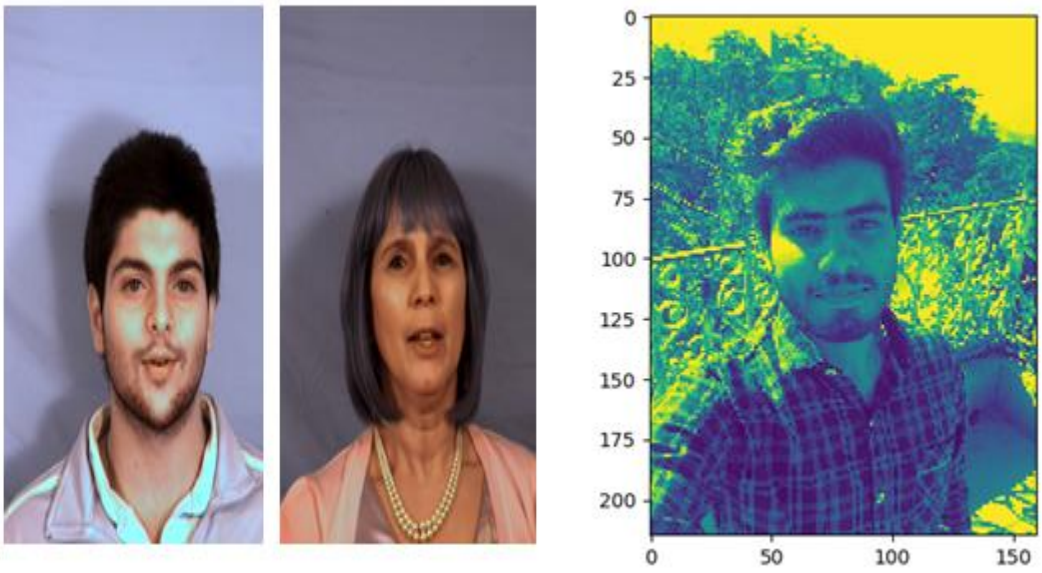

Fig 4.3: PreProcessed

In Fig 4.3, the pre-processed image can be seen and these are two different images which were very large in size but have been reduced to dimension of 160*215 so as to process images faster and as you can notice, these images contain grey background because while processing images they have been converted to greyscale values and they have represented in the figure below i.e. Fig 4.4. The background isn't of any significance when it comes to predicting gender and that's why we ignore it while extracting the features.

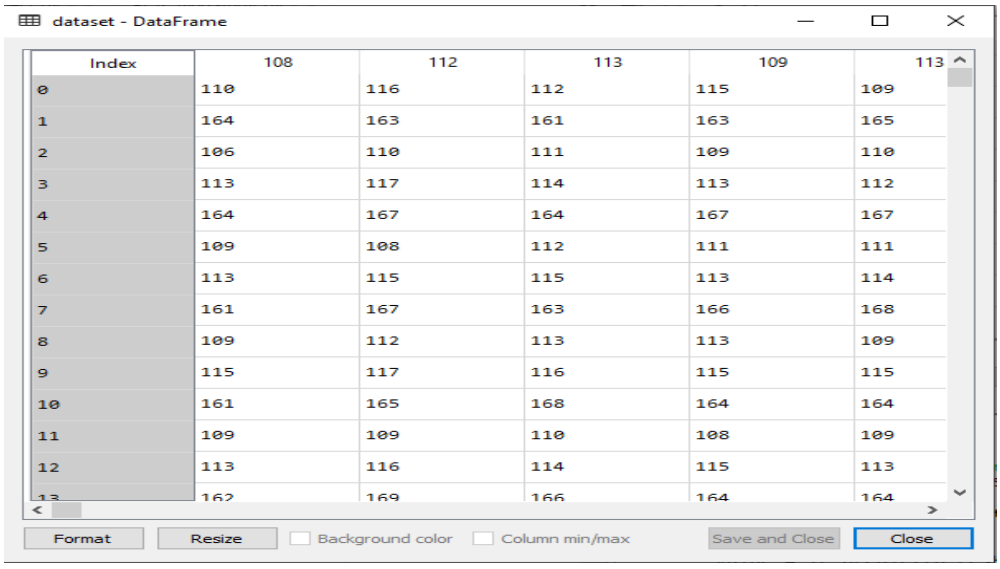

Fig 4.4-DatasetFrame

In figure 4.4, the table shows the various rgb values and the greyscale values of the pre-processed images which depict several parameters passed in figure 4.2. The significance for representation is only to showcase how values of images in pixels are stored.

4.2 Implementation Analysis

```
from sklearn.decomposition import PCA

#PCA for dimensionality reduction
pc = PCA()
dd=pc.fit_transform(X)

# spliting of data in training and test data
X_train, X_test, y_train, y_test = train_test_split(X, Y)
```

Fig 4.5- PCA

In figure 4.5, sklearn i.e. scikit-learn library available for working in Python implementing the machine learning algorithms and various models. In this project the PCA method has been imported to use it for dimensionality reduction so as to ignore features not of importance while extracting image for features such as the background is one of the parameter.The basic aim to do dimensionality reduction using PCA is for speeding up oour machine learning algorithm.

The fit_transform(X) where X represents the dataset is use to normalize the features while visualizing the data.

The model training is done on the dataset consisting males and females images in equal proportion and the training dataset consists of 75% of the dataset while the remaining dataset i.e the 25% datset left is used to test the model.

4.2.1 EigenFace Algorithm

To extract the features from face EigenFace algorithm was used which uses PCA to find eigenface values and with the help of covariance matrix eigenvectors are calculated.

The highest eigenvalues are grouped together and images are classified accordingly.

4.2.2 KNN Algorithm

K-Nearest Neighbour (KNN) which is a procedure used in ML models which fundamentally predicts based on dataset previously available or accessible.

The framework for this algorithm is taught by using images of several people and subsequently different picture is predicted based on dataset in past.

In KNN, K is the number of closest neighbours. Number of neighbours in KNN is the central deciding factor. K is commonly an odd number if the number of classes is 2.

KNN algorithm is a part of sklearn which is the inbuilt python library used for machine learning training algorithms and the figure 4.6 represents the same importing of the KNN algorithm.

In our implementation, the number of neighbours used is 10 as represented in the following figure i.e. fig 4.6 and the training dataset is fit into the model and the score are calculated for both the training and testing which are represented in Fig 4.8.

```
from sklearn.neighbors import KNeighborsClassifier

# KNN fit
Kn = KNeighborsClassifier(n_neighbors = 10)
Kn.fit(X_train,y_train)
Kn.score(X_train,y_train)
Kn.score(X_test,y_test)
```

Fig 4.6- KNN Fit

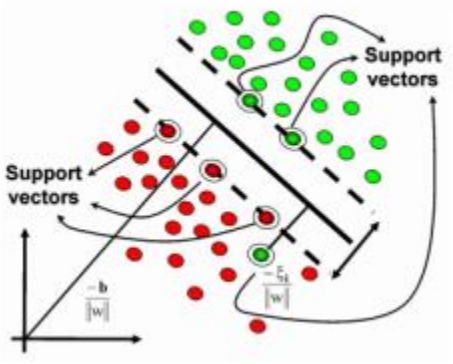

Fig 4.7- Support Vectors

In figure 4.8, the KNN score when n=10 the accuracy is calculated while the training score for the given dataset is 80.8% and the score that came for the testing was around 80% accuracy.

Algorithm	Train Score	Test Score
KNN	0.808	0.80

Fig 4.8- KNN Score

4.2.3 LR Algorithm

Logistic regression is very regularly used machine learning algorithm as it is a suitable regression procedure for solving classification problems binary in nature. For various classification problems Logistic regression algorithm is used such as spam detection, Gender prediction, Diabetes prediction, etc.

LR algorithm is a part of sklearn which is the inbuilt python library used for machine learning training algorithms and the figure 4.9 represents the same importing of the Logistic Regression algorithm.

```
from sklearn.linear_model import LogisticRegression
# Lr fit
lr = LogisticRegression()
lr.fit(X_train,y_train)
lr.score(X_train,y_train)
lr.score(X_test,y_test)
```

Fig 4.9- LR Algorithm

The LR algorithm is fit for using the given database and the score is calculated for both training dataset and the testing dataset which is represented in the figure 4.12

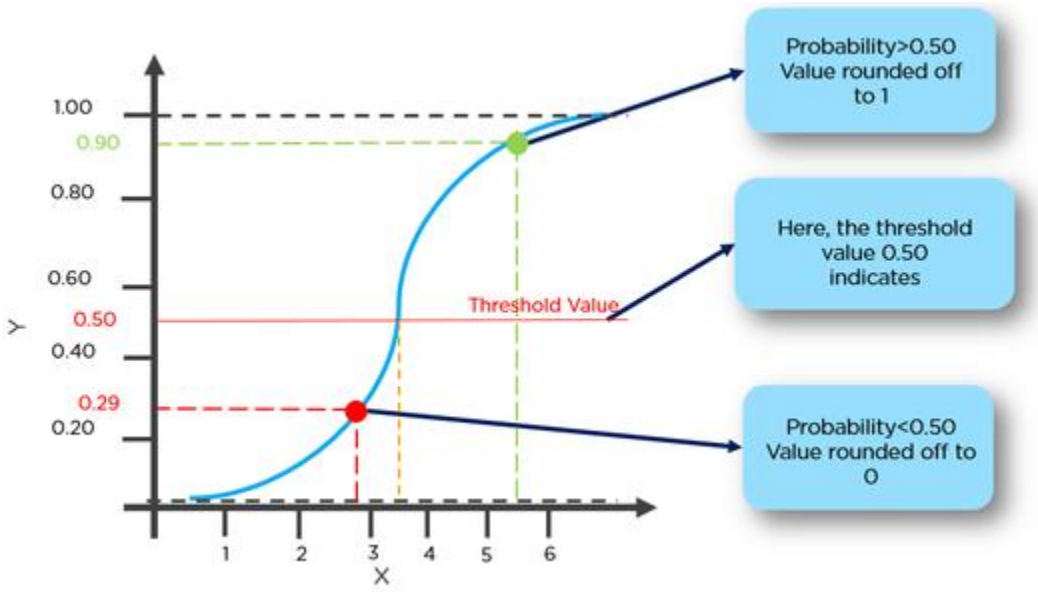

Fig 4.10- LR Model Graph

In Fig 4.10, the LR algorithm how it works is represented by a graphical figure to depict what goes in to behind working of this algorithm.

```
value = lr.predict(d.reshape(1,-1))
if value == 1:
    print("Male")
elif value == 0:
    print("Female")
```

Fig 4.11- LR Predict

In fig 4.11, the LR Algorithm predicts the values for the test image and depending upon the value the gender is predicted. If the value is calculated as 1 the result printed is Male else if value is 0, ther resulrt is predicted asd female.

Algorithm	Train Score	Test Score
LR	1.00	0.96

Fig 4.12.1- LR Result

In figure 4.12.1, the score for the training and testing of the model for the databse are given.

While the accuracy was 100% when training the dataset for the model but in case of testing the LR algorithm the accuracy or the score was 96%. In fig 4.12.2 the gender prediction made on the user input image is predicted as “Male”.

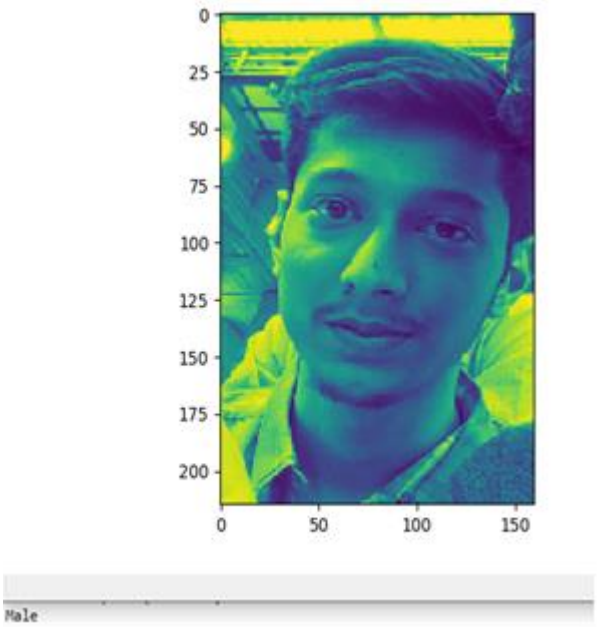

Fig 4.12.2- LR Prediction

4.2.4 CNN Algorithm

Now the very next step in our projects phase was implementing the gender detection technique in real time and we tried to achieve these using CNN i.e. Convolutional Neural Networks with the help of deep learning.

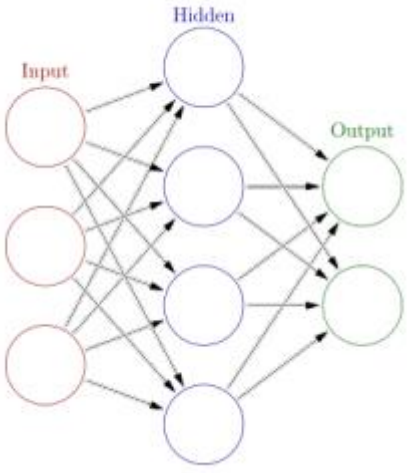

Fig 4.13- CNN Architecture

The above figure i.e. 4.13 represents how the CNN architecture looks like.
The input to the CNN is the images or the real time face using integrated webcam with the help of tensorflow and then the machine learning model detects the features of face and then finally gives the output as per the calculation or the prediction made by the model.

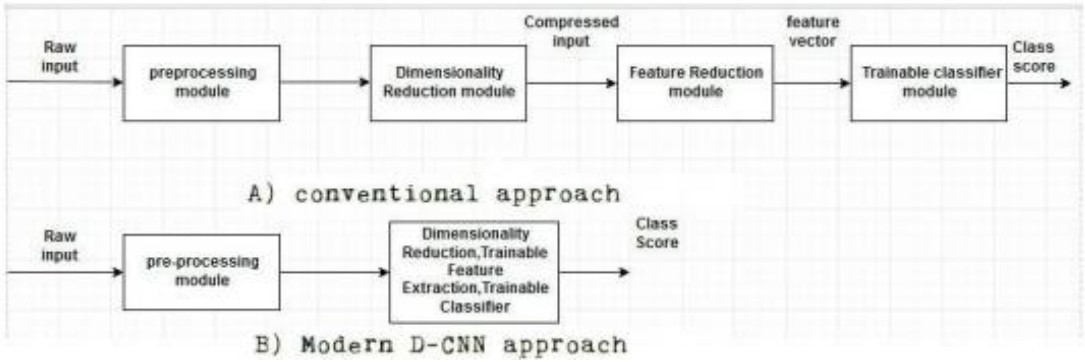

Fig 4.14- CNN Approach

The fig 4.14 represents the two different types of approach comparison. The phase 1 of this project uses Approach (a) i.e Conventional Approach while the next phase which we are discussing currently makes use of Modern D-CNN Approach i.e approach (b) as per the figure.
The pre-trained neural model has been used which is caffe model and the same has 2 files. The description of these two files inside caffee model is as follows-

1 .prototxt — CNN has been define here. All the layers that are present in our neural network have been defined by this file which includes what every layers will have as inputs, outputs and functionality would be.

2 .caffemodel —This model contains information regarding the trained model for the neural network.

Fig 4.15- Accuracy and Loss in Epoch

As per the above figure i.e. Fig 4.15, CNN, gives better and more accurate results as compared to KNN and LR algorithms used previously. The CNN approach gave result as an average of 90% validation accuracy which came after 10 epochs for gender. When it come to validation accuracy of variance, one will notice that it is not that high the reason for which is the use of lesser validation samples

The accuracy of our model depends on the number of the training samples. To improve accuracy we need to provide model with the more samples.

Further we will show the code snippets which show how the python and libraries were used with the caffe model to implement the project.

The fig 4.16 and fig 4.17 represent the code implementation.

Python has an inbuilt-library epoch which has been used to represent the graphical figure.

The python library “epoch” represents a set of routines which are used to help with the management of time of UNIX epoch timestamps for evry second generation of data, including generation, adjustment, and parsing.

```
parser=argparse.ArgumentParser()
parser.add_argument('--image')

args=parser.parse_args()

faceProto="opencv_face_detector.pbtxt"
faceModel="opencv_face_detector_uint8.pb"



genderProto="gender_deploy.prototxt"
genderModel="gender_net.caffemodel"


genderList=['Male','Female']

faceNet=cv2.dnn.readNet(faceModel,faceProto)
ageNet=cv2.dnn.readNet(ageModel,ageProto)
genderNet=cv2.dnn.readNet(genderModel,genderProto)
```

Fig 4.16- Caffe Model Snippet (A)

In figure 4.16, you will notice that the argument as been passed as an image (‘-- image’) and to detect face the protxt and caffe models have been fitted in with the input which when the webcam receives or notices a face captures the face in real time and passes it to the gender model where with the help of same CNN model gender is detected.

While the gender list contains Male and Female respectively. What results are have been calculated using the DNN as the protxt and caffee model files are read.

```
video=cv2.VideoCapture(args.image if args.image else 0)
padding=20
while cv2.waitKey(1)<0 :
    hasFrame,frame=video.read()
    if not hasFrame:
        cv2.waitKey()
        break

    resultImg,faceBoxes=highlightFace(faceNet,frame)
    if not faceBoxes:
        print("No face detected")

    for faceBox in faceBoxes:
        face=frame[max(0,faceBox[1]-padding):
                   min(faceBox[3]+padding,frame.shape[0]-1),max(0,faceBox[0]-padding)
                   :min(faceBox[2]+padding, frame.shape[1]-1)]

        blob=cv2.dnn.blobFromImage(face, 1.0, (227,227), MODEL_MEAN_VALUES, swapRB=False)
        genderNet.setInput(blob)
        genderPreds=genderNet.forward()
        gender=genderList[genderPreds[0].argmax()]
        print(f'Gender: {gender}')
```

Fig 4.17- Caffe Model Snippet (B)

In fig 4.17, the tensorflow integrates the webcam and the snippet has a while loop which tells that webcam is going to wait until some key is entered and the webcam will be exited.

Alternatively, if there is no input for a time the webcam will exit because since no faceboxes will be made and will print “No face detected”. If a face detected a facebox will appear around the face and accordingly fitted into the model you will see the result in the real time.

There are two cases available, the first case when a user wishes to give an input as results have been shown in fig 4.18 and fig 4.19 and the second case when consumer desires to make use of real time gender detection i.e. make use of webcam and the result of which as been displayed in fig 4.20 and fig 4.21.

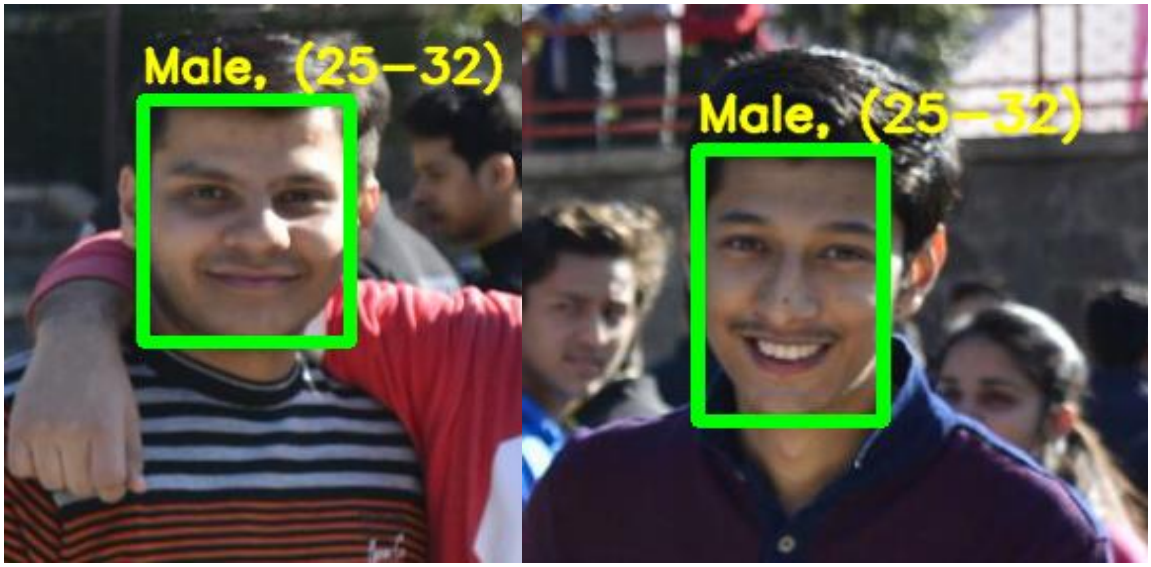

Fig 4.18- User Input Result (A)

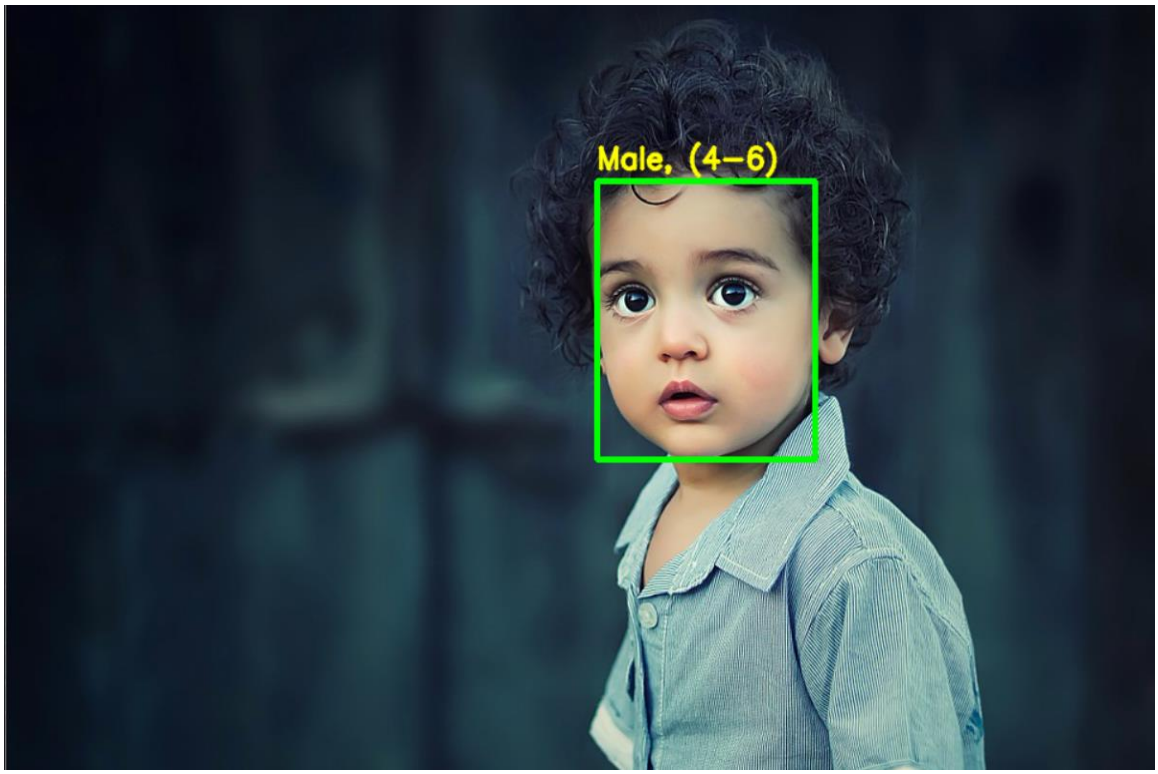

Fig 4.19- User Input Result (B)

Inspired by the Mi's front camera to predict your age case 1 i.e input from the users was tried to train on the age model using the same CNN algorithm but the accuracy was poor and discarded for the time.

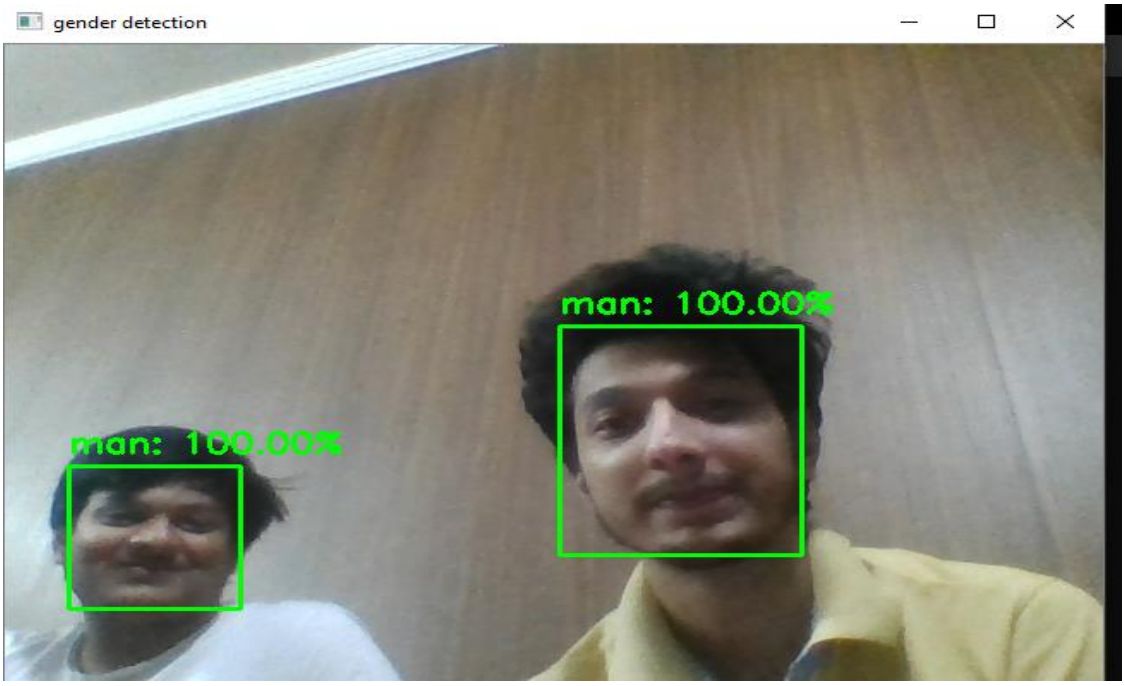

Fig 4.20- Real Time Webcam Result (A)

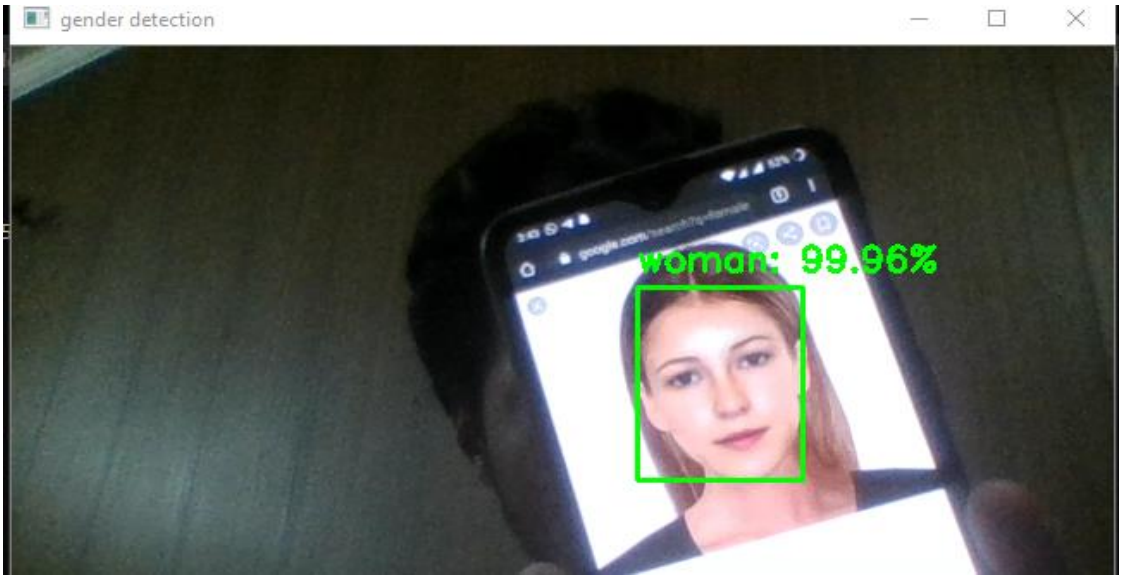

Fig 4.21- Real Time Webcam Result (B)

In fig 4.20, using integrated webcam the faces are detected and along with that what accuracy of the gender prediction is also given. The both real time inputs have been predicted as male with 100% accuracy. In fig 4.21, a random female image has been used to check the model for Female predictions and accuracy of the prediction was around 99.96%.

Above results show the successful implementation of both the cases with an accuracy of more than 90% and thus we can safely say that our model can detect gender in real time and for an image given as an input for single or multiple faces at a time as well.

CHAPTER-5
CONCLUSIONS

5.1 Conclusions

Finally concluding the project, this chapter of our report is to discus the future possibilities in work I plan(s) to execute in the near future with UI implementaion. After perusing various research papers, that talked really about different procedures which have been implemented up until now to detect the face i.e. face recognition.

The comparison of different face recognition algorithms was made along with upsides and downsides which have resulted me to pick an algorithm so powerful which could resist managing image that might contain bad illumination condition or occlusion.

The framework was studies carefully on which testing procedures can be done.

The purpose of project is basic however a viable technique for recognition maintaining the strategic distance from pointless complexities that can act as an obstruction for unaffected execution. Discussion about robustness of various algorithms with memory prerequisites handling time. The whole project implementation was centered around implementing real time face detection, integrating webcam with help of various research papers available as customary, simple yet an operational algorithm for gender recognition.

Starting at now the venture just considers situations where the pictures are caught during a suited lightening condition (bright) and additional work maybe done to study instances of night as well. The criminal detection can help to identify male and female convict and also with the help of facial features the criminal can be caught.

Most of the devices now use Face Unlock which also works on a very similar algorithm as they use your face capturing to capture facial features and accordingly use them to unlock.

5.2 Future Scope

Methods or techniques which work on multi-view slants or angles of human face unlike just the frontal view so that downside while recognizing the face can be overcome.

Face unlock doesn't work if you cover your face with masks.

Techniques must be applied so that the partially occluded face must be recognized.

Not just the male or female the system must be able to differentiate between genders like male, female and transgender because hardly any work exists on how transgender too can be identified.

5.3 Applications / Contributions

Facelytics is a website that helps to detect your gender i.e. if you are a man or a woman in real time along with an age estimation along with multiple face detection.
They provide with SDK and APIs to help you work on answers which saves on cloud.

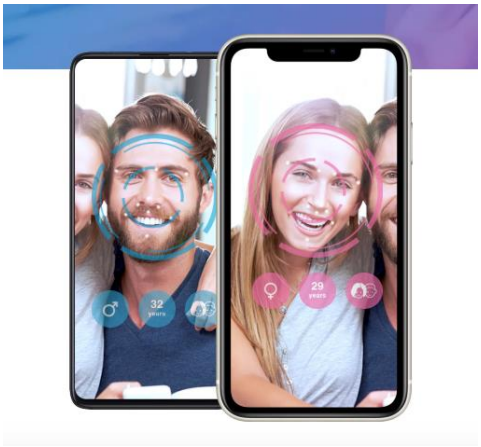

Fig 5.1: Facelytics

Quividi, an AI software which users can use to detect age and gender who makes use of their online face analyses.

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