A STUDY PAPER ON MODERN FACIAL RECOGNITION SYSTEM USING DEEP LEARNING

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ABSTRACT

A human brain can store and remember thousands of faces in a person's lifetime; however, it is very difficult for an automated system to reproduce the same results. Faces are complex and multidimensional which makes extraction of facial features to be very challenging, yet it is imperative for our face recognition systems to be better than our brain's capabilities. With the arrival of Deep Learning model, feature generation from faces are now more effective and near to accuracy. Company's like Google Inc. and Facebook are investing heavily in this approach, their projects like DeepFace and FaceNet are examples of modern face recognition technologies.

KEYWORDS : *Facial Recognition Systems, DeepFace, FaceNet, Eigen Faces, Deep Learning*

INTRODUCTION

A face recognition system is a system that can use a person's facial properties for identification, verification or recognition. Early facial recognition systems used principal component analysis in generating face features which is then called as Eigen faces. [1]

Eigen faces are more of a lower dimensional representation of a face image i.e. consider a cropped face image. With the arrival of Deep Learning model, feature generation from faces are now more effective and near to accuracy. [2]

HISTORY

During 1964 and 1965, Bledsoe, in conjunction with Helen Chan and Charles Bisson, worked on using the computer to recognize human faces. He was proud of this work, but because the funding was provided by an anonymous intelligence agency that did not allow much publicity, little of the work was published then. He described the difficulties as follows:

"This recognition problem is made difficult by the great variability in head rotation and tilt, lighting intensity and angle, facial expression, aging, etc. Some other attempts at face recognition by machine have allowed for little or no variability in these quantities. Yet the method of correlation (or pattern matching) of unprocessed optical data, which is often used by some researchers, is certain to fail in cases where the variability is great. In particular, the correlation is very low between two pictures of the same person with two different head rotations."

— Woody Bledsoe, 1966 [1]

This project was labelled man-machine because the human extracted the coordinates of a set of features from the photographs, which were then used by the computer for recognition.

Understanding Facial Recognition.

The first important factor in facial recognition systems is its ability to differentiate

between the background and face. This is especially important when the algorithm must identifya face within a crowd.

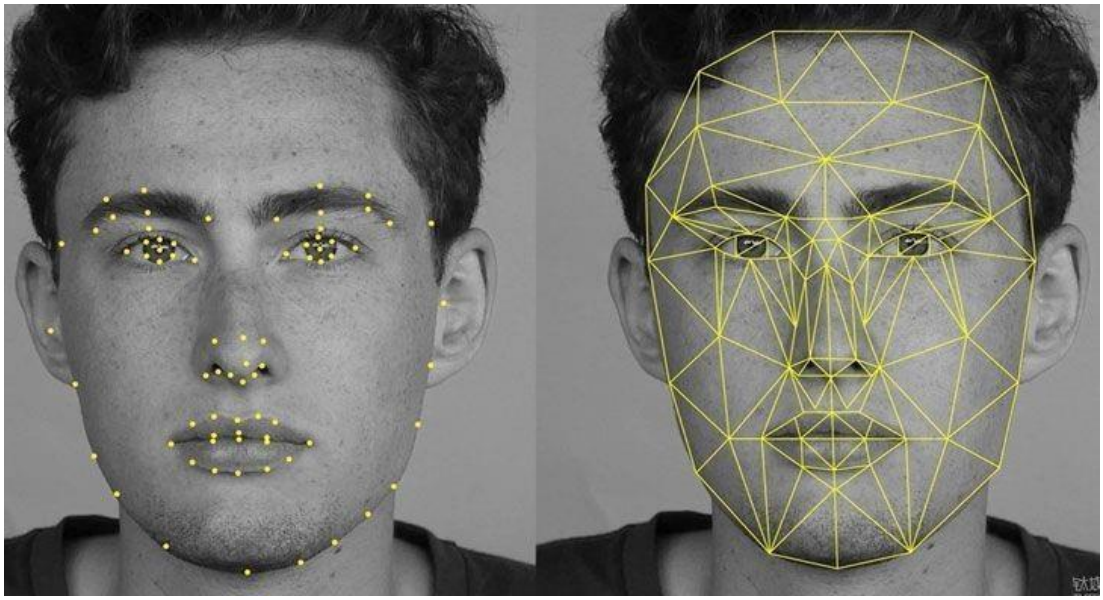

Figure 1 - A Face with Its Nodes

There are roughly 80 nodes comprising the face print that the system makes use of and this includes the jaw line length, eye socket depth, distance between the eyes, cheekbone shapeand the width of the nose as shown above. [2] [3]

The algorithm then makes use of a person's facial features, it's peaks and valleys and landmarks and treats these as nodes that can be measured and compared against those that arestored in the systems. [2]

Other algorithms normalize a gallery of face pictures and then compress the face data,solely saving the data in the image that is useful for face recognition. A probe picture is then compared with the face data. [2]

Deep Learning for Better Face Features

The state-of-the-art faces recognition technologies now use Labeled faces in the wild benchmark to increase the effectiveness, accuracy and efficiency of Face recognition systems. Currently the leading models are all Deep Learning models, such as Google's FaceNet & Facebook's DeepFace who both have accuracy of 97.35% and 99.63% compared to the originalEigenfaces which has an accuracy of 60% [4] [5]

Components of a Face Recognition System

To build a face recognition system there are some basic components that your applicationshould have:

- Face Detection and alignment component
- For most face recognition systems its important to detect the facial portion from the
- images so that only face of the body is in focus and background is blurred out. The conventionalpipeline used in DeepFace is
- Detect ⇒ align ⇒ represent ⇒ classify
- A face feature generating model
- After detecting the face from the image, the face portion should be transformed into amodel to create a face map with the help of facial features. DeepFace uses 67 facial points to generate a 3D model with the help of feature alignment. [6]
- A final metric learning layer for Verification/Identification/Recognition
- After the model or a face map is generated a metric learning algorithm or some other distance calculating algorithms compare the generated features for closeness in distance.
- DeepFace uses cosine metrics or sometimes Siamese networks. [6]

DeepFace

In modern face recognition, the conventional pipeline consists of four stages: detect ⇒ align ⇒ represent ⇒ classify. But in DeepFace both alignment and the representation steps areused to create explicit 3D modeling to apply piecewise transformation and create a face representation with the help of nine-layer deep neural network. [3]

Figure 2 – Alignment Pipeline

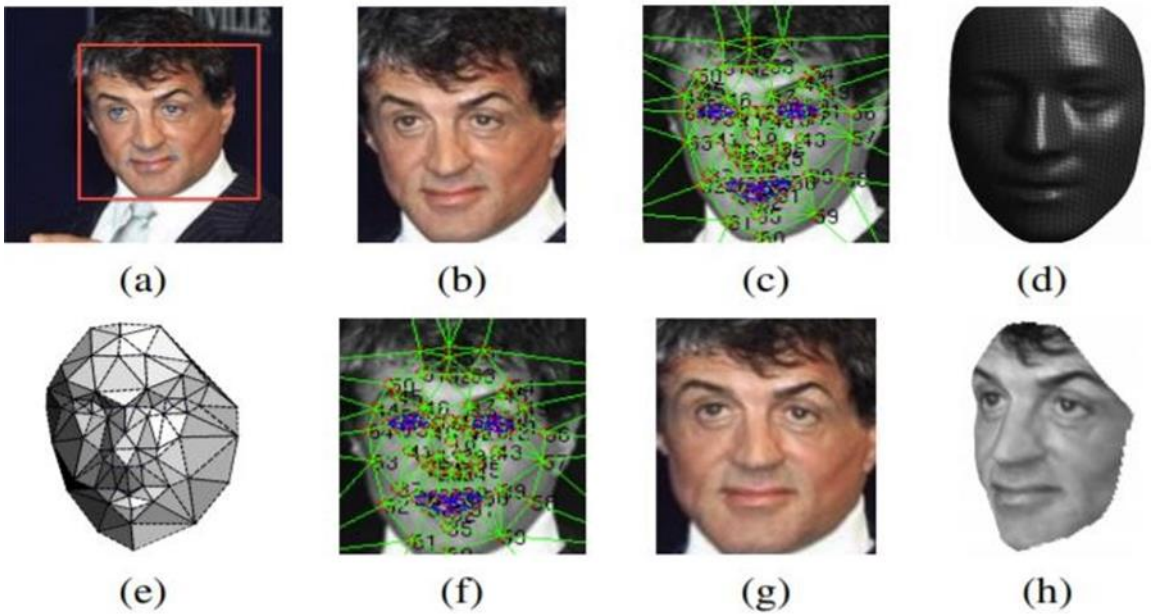

Figure 2 – Alignment Pipeline

a) 2D alignment process starts by detecting 6 “fiducial points” using SVR (Support Vector Regressor).
b) After detecting iteratively scale rotate and transform image until it aligns with a target faceand create a 2D aligned crop.
c) Capture 67 fiducial points on the 2D aligned crop with their corresponding Delaunay triangulation to avoid discontinuities.

The reference 3D shape is then transformed in to a 2D aligned crop image-plane forfeature alignment.

a) The triangle visibility with respect to the fitted 3D-2D camera so that the darker trianglesare less visible.
b) The 67 fiducial points induced by the 3D model are now used to direct the piecewiseaffine warping
c) The final frontolyzed crop image is generated to be used for creating different kinds ofviews.
d) And finally, the new view is generated by the 3D model which can be used for facial recognition. [7]

Datasets

i. The DeepFace algorithm uses large set of data sets for learning process it has acces of large collection of photos from Facebook, classified into Social Face Classification (*SFC*)
ii. Datasets. Which includes 4.4 million labeled faces, where recent 5% of face images of each identity are left out for testing. [8] [7]
iii. The Labeled faces in the wild (*LFW*) datasets consists of 13,323 web photos s of 5,749 celebrities which are divided into 6,000 face pairs in 10 splits. Performance here is measured by mean recognition accuracy using restricted protocol, the unrestricted protocol and an unsupervised setting. [9] [7]
iv. The YouTube Video Faces (*YTF*) dataset collects 3,425 YouTube videos of 1,595 subjects which is nothing but a subset of LFW. These videos are divided into 5,000 video pairs and 10 splits and used to evaluate the video-level face verification. [5] [7]

DeepFace Summarized

DeepFace processes images of faces in two steps. First it corrects the angle of a face so that the person in the picture faces forward, using a 3-D model of an "average" forward-looking face. Then the deep learning comes in as a simulated neural network works out a numerical description of the reoriented face. [10]
If DeepFace comes up with similar enough descriptions from two different images, it decides they must show the same face. The deep-learning part of DeepFace consists of nine layers of simple simulated neurons, with more than 120 million connections between them. [11]

APPLICATIONS

Facebook currently uses different facial recognition algorithms to suggest friends when tagging photos. One of the factors used in the current algorithm includes the distance between auser's eyes and nose in multiple photos. Facebook may sometimes suggest the wrong people to tag because of similarities in facial structures between multiple friends, which could potentially be fixed with DeepFace. Since they have access to lots of data, they can successfully train a high-capacity model. [7] [11]

CONCLUSION

Facebook's DeepFace has an accuracy rate of 97.25% even after that Facebook did not celebrate or bragged about their achievement but silently suggesting users for tag selection while uploading images. They didn't brag simply because they are aware of the potential damage and that's why they are calling it a research project rather than business feature. [5]
There's a business purpose behind all this intellectual enthusiasm that compony has been showing mostly because they have the ability of understanding all the information user post on the social network is central to Facebook's business model, which leverages data to personalize ads so user will be more likely to click on them. [9] Facebook's growing ability to recognize people when their friend uploads photos from avacation together or simply uploading the current status has caught the attention of privacy advocates and government officials more than the researcher. [8]. More privacy-conscious European governments have already forced Facebook to delete all its facial recognition data there which raise more question upon the need of Face detection system like DeepFace than Appraise. [10]

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6G: A LINK TO 5G NETWORK

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ABSTRACT

The paper deals with short comparison between 1G,2G,3G,4G,5G and study of upcoming 6g technology. The standardization of fifth generation (5G) communications has been completedand the 5G network should be commercially launched in 2020's. The visioning and planning of 6G communications has begun, with an aim to provide communications services for the future demands of the 2030's. High data security, High throughput and eMBB should be key features of 6G and should be given particular attention by the wireless research community.

KEYWORDS : *Arhitecture, Holographic MIMO Surfaces, Business Cases*

INTRODUCTION

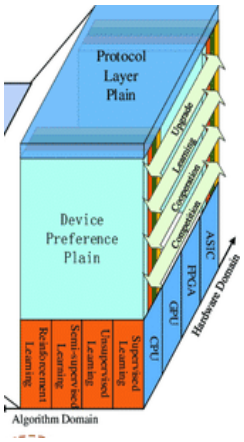
Mobile Technology has evolved drastically in the last decades. These technology has marked their significance in our day to day work. As we all know, the mobile technology has risen from 1G in 1970's to 5G in 2020's. Below is the short comparisonbetween 1G,2G,3G,4G,5G:

	KEY Points	**1G**	**2G**	**3G**	**4G**	**5G**
1	**Deployment**	1970-1984	1980-1999	1990-2002	2000-2010	2020-2030
2	**Bandwidth**	2 Kbps	14-64 Kbps	2 Mbps	20 Mbps	>1Gbps
3	**Service**	Mobile Telephony	Digital Voice, Short Messaging	Integrated High Audio, Video & Data	Dynamic Information Access, Variable Devices	Dynamic Information Access, Variable Devices with AI capabilities

4	**Technology**	Analog Cellular	Digital Cellular	Broadband/ CDMA/ IP Technology	Unified IP & Seamless combo of LAN/ WAN/ WLAN /PAN	4G+WWW
5	**Core Network**	PSTN	PSTN	Packet Network	Internet	Internet

5G networks will not have the capacity to deliver a completely automated and intelligent network that provides everything as a service and a completely immersive experience 5G networks will not have the capacity to deliver a completely automated and intelligent network that provides everything as a service and a completely immersive experience. Then, 6G will fill the gap between 5G and the market demand. Based on the previous trends and predictions of future needs, the main objectives for the 6G systems are extremely high data rates per device a very large number of connected device sglobal connectivity very low latency lowering the energy consumption with battery-free IOT devices ultra-high reliable connectivityconnected intelligence with machine learning capability. One of the goals of the 6G Internet will be to support one micro-second latency communications, representing 1,000 times faster or 1/1000th the latency than one millisecond throughput. 6G will have big implications for many government and industry solutions in public safety and critical asset protection such as:
Threat Detection, Health monitoring, Feature and Facial recognition, Decision making (in areas like law enforcement and social credit systems), Air quality measurements, Gas and toxicity sensing.

Architecture of 6G



The 6G system will increase performance and maximize user QoS several folds more than 5G along with some exciting features. It will protect the system and secure the user data. It will provide comfortable services. The 6G communication system is expected to be a global communication facility. It is envisioned that the per-user bit rate in 6G will be approximately 1 Tb/s in many cases. Moreover, ultra-long-range communication with less than 1- ms latency is also expected. The most exciting feature of 6G is the inclusion of fully supported AI for driving autonomoussystems. Video-

type traffic is likely to be dominant among various data traffic systems in 6G communications. The most important technologies that will be the driving force for 6G are the terahertz (THz) band, AI, optical wireless communication (OWC), 3D networking, unmanned aerial vehicles (UAV), and wireless power transfer. In this paper, we describe how 6G communication systemscan be developed; we also describe the expected 6G technologies, and the researchissues required to address the needs of future smart networks.

Telecom Network Progression by Generation:

Network Generations	Introduction Year	Top Speeds
1G	1979	2 Kbps
2G	1991	100 Kbps
3G	1998	8 Mbps
4G	2010	150 Mbps
5G	2020	10 Gbps
6G	2030(Expected)	1 Tbps

1. Expected Speed of 6G network

As the network generations are evolved, it is obvious to observe increase in their speeds. A movie which was taking a time of 20s will be downloaded in less than 1susing 6G Internet. The Centre for Converged TeraHertz Communications and Sensing says it's investigating new radio technologies that will make up 6G. "According to the researchers, this will allow for the extreme densification of communication systems, enabling hundreds and even thousands of simultaneous wireless connection, with 10 to 1,000 times higher capacity than the nearer-term 5G systems and network". Augmented reality and next-level imaging and sensing with a terahertz imaging radar are only some of the potential applications. Future 6G wireless communication systems are expected to realize an intelligent and software reconfigurable functionality paradigm, where all parts of device hardware will adapt to the changes of the wireless environment.

2. Holographic MIMO Surfaces

3.

Massive MIMO, three-Dimensional (3D) beamforming, and their hardware efficient hybrid analog and digital counterparts provide remarkable approaches to conquer signal attenuation due to wireless propagation via software based control of the directivity of transmissions, they impose mobility and hardware scalability issues. Being a newly proposed concept going beyond massive MIMO, Holographic MIMO Surfaces (HMIMOS) are low cost, size, weight, and low power consumption hardware architectures that provide a transformative means of the wireless environment into a programmable smart entity. To realize reconfigurable wireless environments, HMIMOS can serve as a transmitter, receiver, or reflector. When thetransceiver role is considered, and thus energy-intensive Radio Frequency (RF) circuits and signal processing units are embedded in the surface, the term active HMIMOS is adopted.

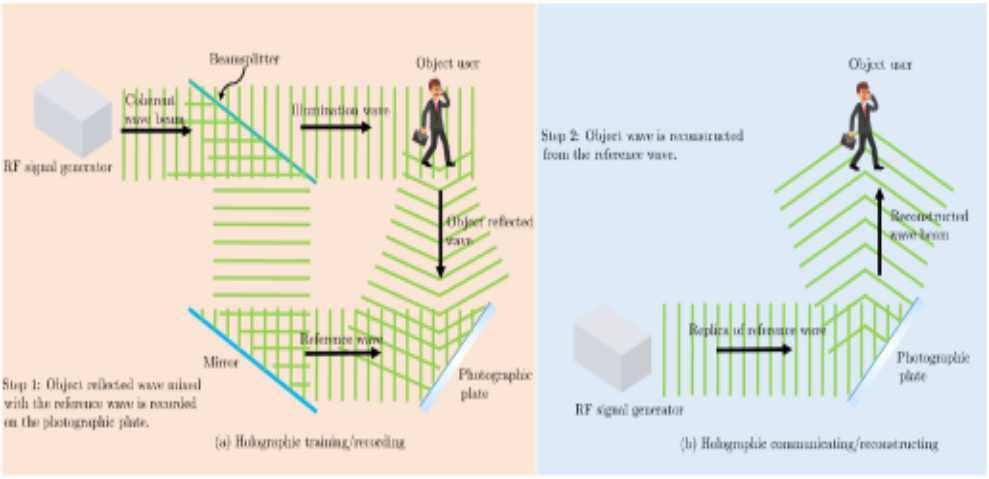


Fig. -The two generic steps of holographic training/recording and holographic communication/reconstruction

Business cases of 6G

Artificial Intelligence: The most important and newly introduced technology for 6G communication systems is AI [26]–[30]. There was no involvement of AI for 4G communication systems. The upcoming 5G will support partial or very limited AI. However, 6G will be fully supported by AI for automatization. Optical wireless technology: OWC technologies are envisioned for 6G communications in addition to RF-based communications for all possible device- to-access networks; these networks also access network-to-backhaul/fronthaul network connectivity

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Blockchain: Blockchain will be an important technology to manage massive data in future communication systems. The data on a blockchain is gathered together and structured in blocks. The blocks are connected to one another and secured using cryptography. The blockchain is essentially a perfect complement to the massive IoT with improved interoperability, security, privacy, reliability, and scalability. Autonomic interactions of different IoT systems, and reliability for the massive connectivity of 6G communication systems.

3D networking: The 6G system will integrate the ground and airborne networks to support communications for users in Draft the vertical extension.

CONCLUSION

Today mobile phones consist of everything ranging from the smallest size, largest phone memory, speed dialling, video player, audio player, and camera and so on. The 6th generation (6G) wireless mobile communication networks integrate satellites for global coverage. It can be a combination of nanocore and artificial intelligence, where all the network operators will be connected to one single core. As in evolution and explosion, many will become extinct but some will change the world. In 6G the cost of mobile call will be relatively high but in 7G this problem will be improved and the cost of call will be reduced and lower level user will be benefited.

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