CHAPTER – 1

INTRODUCTION

Face recognition is one of the most important applications of biometrics based authentication system in the last few decades. Face recognition is kind of recognition task pattern, where a face is categorized as either known or unknown after comparing it with the images of a known person stored in the database.

Face recognition isa challenge, given the certain variability in information because of random variation across different people, including systematic variations from various factors such as lightening conditions and pose. Computationalmethods offace recognitionneed to address numerous challenges. These types of difficulties appear because faces need to be represented in such a way that best utilizes the available face information to define a specific face from all the other faces in the database. Face pose is a specifically difficult problem in this aspect simply because all faces seem similar; specifically, all faces consist of two eyes, mouth, nose, and other features that are in the same location.

The human face is an extremely complex and dynamic structure with characteristics that can significantly and quickly change in time. Face recognition involves a range of activities from variousaspects of human life. Humans can recognize faces, but too many faces sometimes being hard to memorized, machine learning is now being improved to do this task. Scientists attempt to understand the architecture of the human face whenbuilding ordeveloping face recognition systems.

DIFFERENT APPROACHES OF FACE RECOGNITION: There are two predominant approaches to the face recognition problem: Geometric (feature based) and photometric (view based). As researcher interest in face recognition continued, many different algorithms were developed, three of which have been well studied in face recognition literature. Recognition algorithms can be divided into two main approaches:

1. **Geometric:** Is based on geometrical relationship between facial landmarks, or in other words the spatial configuration of facial features. That means that the main geometrical features of the face such as the eyes, nose and mouth are first located and then faces are classified on the basis of various geometrical distances and angles between features.

2. Photometric stereo: Used to recover the shape of an object from a number of images taken under different lighting conditions. The shape of the recovered object is defined by a gradient map, which is made up of an array of surface normals (Zhao and Chellappa, 2006).
The face detection system can be divided into the following steps:-

1. Pre-Processing: To reduce the variability in the faces, the images are processed before they are fed into the network. All positive examples that is the face images are obtained by cropping Department of ECE Page 3 images with frontal faces to include only the front view. All the cropped images are then corrected for lighting through standard algorithms.

2. Classification: Neural networks are implemented to classify the images as faces or non-faces by training on these examples. We use both our implementation of the neural network and the Mat lab neural network toolbox for this task. Different network configurations are experimented with to optimize the results.

3. Localization: The trained neural network is then used to search for faces in an image and if present localize them in a bounding box. Various Feature of Face on which the work has done on:- Position Scale Orientation Illumination.

CHAPTER -2

LITERATURE REVIEW

World Academy of Science, Engineering and Technology International Journal of Computer and Information Engineering Vol:2, No:7, 2008 :BY A. S. Tolba, A.H. El-Baz, and A.A. El-Harby

FACE recognition is an important research problem spanning numerous fields and disciplines. This because face recognition, in additional to having numerous practical applications such as bankcard identification, access control, Mug shots searching, security monitoring, and surveillance system, is a fundamental human behaviour that is essential for effective communications and interactions among people. A formal method of classifying faces was first proposed in

The author proposed collecting facial profiles as curves, finding their norm, and then classifying other profiles by their deviations from the norm. This classification is multi-modal, i.e. resulting in a vector of independent measures that could be compared with other vectors in a database. Progress has advanced to the point that face recognition systems are being demonstrated in real-world settings.

The rapid development of face recognition is due to a combination of factors: activedevelopment of algorithms, the availability of a large databases of facial images, and a methodfor evaluating the performance of face recognition algorithms. In the literatures, face recognition problem can be formulated as: given static (still) or video images of a scene, identify or verify one or more persons in the scene by comparing with faces stored in a database.

Manuscript received February 22, 2005. A. S. Tolba is with the Information Systems Department, Mansoura University, Egypt, (e-mail: tolba1954@)yahoo.com). A. H. EL-Baz is with the Mathematics Department, Damietta Faculty of Science, New Damietta, Egypt, and doing PhD research on pattern recognition (phone: 0020-57-403980; Fax: 0020-57–403868; e-mail: ali_elbaz@yahoo.com). A. H. EL-Harby is with the Mathematics Department, Damietta Faculty of Science, New Damietta, Egypt, (e-mail: elharby@yahoo.co.uk).: Face recognition is a biometric approach that employs automated methods to verify or recognize the identity of a living person based on his/her physiological characteristics.In general, a biometric identification system makes use of either physiological characteristics (such as a fingerprint, iris pattern, or face) or behaviour patterns (such as hand-writing, voice, or key-stroke pattern) to identify a person. Because of human inherent protectiveness of his/her eyes, some people are reluctant to use eye identification systems. Face recognition has the benefit of being a passive, non-intrusive system to verify personal identity in a “natural” and friendly way.In general, biometric devices can be explained with a

threestep procedure(1) a sensor takes an observation. The type of sensor and its observation depend on the type of biometric devices used. This observation gives us a “Biometric Signature” of the individual.(2) a computer algorithm “normalizes” the biometric signature so that it is in the same format (size, resolution, view, etc.) as the signatures on the system’s database. The normalization of the biometric signature gives us a “Normalized Signature” of the individual.(3) a matcher compares the normalized signature with the set (or sub-set) of normalized signatures on the system's database and provides a “similarity score” that compares the individual's normalized signature with each signature in the database set (or sub-set).

Face Recognition: A Literature Survey W. ZHAO Sarnoff Corporation R. CHELLAPPA University of Maryland P. J. PHILLIPS National Institute of Standards and Technology AND A. ROSENFELD University of Maryland

As one of the most successful applications of image analysis and understanding, face recognition has recently received significant attention, especially during the past several years. At least two reasons account for this trend: the first is the wide range of commercial and law enforcement applications, and the second is the availability of feasible technologies after 30 years of research. Even though current machine recognition systems have reached a certain level of maturity, their success is limited by the conditions imposed by many real applications. For example, recognition of face images acquired in an outdoor environment with changes in illumination and/or pose remains a largely unsolved problem. In other words, current systems are still far away from the capability of the human perception system. This paper provides an up-to-date critical survey of still- and video-based face recognition research. There are two underlying motivations for us to write this survey paper: the first is to provide an up-to-date review of the existing literature, and the second is to offer some insights into the studies of machine recognition of faces. To provide a comprehensive survey, we not only categorize existing recognition techniques but also present detailed descriptions of representative methods within each category. In addition, relevant topics such as psychophysical studies, system evaluation, and issues of illumination and pose variation are covered.

Second International Symposium on Computer Vision and the Internet(VisionNet’15) Future of Face Recognition: A Review Shwetank Arya*, Neeraj Pratap, Karamjit Bhatia Department of Computer Science, GKV, Haridwar, India Abstract The Face Recognition (FR) is growing as a major research area because of the broad choice of applications in the fields of commercial and law enforcement. Traditional FR methods based on Visible Spectrum (VS) are facing challenges like object illumination, pose variation, expression changes, and facial disguises. Unfortunately these limitations decrease the performance in object identification and verification. To overcome all these limitations, the Infrared Spectrum (IRS) may be used in human FR. So it leads and encourages the

researchers for continuous research in this area of FR. Simultaneously, the present study emphasizes the use of three dimensional cubic dataset i.e. Multi/ Hyperspectral Imagery Data in FR. The IR based Multi/ Hyperspectral Imaging System can minimize the several limitations arise in the existing and classical FR system because the skin spectra derived with cubic dataset depicts the unique features for an individual. Multi/ Hyperspectral Imaging System provides valuable discriminants for individual appearance that cannot be obtained by additional imaging system that's why this may be the future of human FR. This paper also presents a detailed and time to time review of the literature on FR in IRS.

Face Recognition and Verification: A Literature Review Published 2017, Aditi Upadhyay, Sudhir Kumar Sharma

Face recognition and verification has been actively researched in recent years as information and data accumulating in abundance, and there is a crucial need for high security has received more attention. As face recognition, useful for a person's authentication is quite simple and non-intrusive method that recognizes faces in complex multidimensional visual model and also a computational model for it. In this paper we try to present an overview of face recognition and verification including its applications thereafter face recognition techniques listing their advantages and disadvantages. Finally, their conclusions are also given.

Face Recognition: A Literature Review Reza Shoja Ghiass† , Ognjen Arandjelovic´ ‡ , Hakim Bendada† , and Xavier Maldague† † Universite Laval, Quebec, Canada ´ ‡ Deakin University, Geelong, Australia

In the last two decades AFR has consistently been one of the most active research areas of computer vision and applied pattern recognition. Systems based on images acquired in the visible spectrum have reached a significant level of maturity with some practical success. However, a range of nuisance factors continue to pose serious problems when visible spectrum based AFR methods are applied in a real-world setting. Dealing with illumination, pose and facial expression changes, and facial disguises is still a major challenge. There is a large corpus of published work which has attempted to overcome the aforesaid difficulties by developing increasingly sophisticated models which were then applied on the same type of data – usually images acquired in the visible spectrum (wavelength approximately in the range 390 − 750 nm). Pose, for example, has been normalized by a learnt 2D warp of an input image , generated from a model fitted using an analysis-by-synthesis approach or synthesized using a statistical method , while illumination has been corrected for using image processing filters and statistical facial models , amongst others, with varying levels of success. Other methods adopt a multi-image approach by matching sets or sequences of images . Another

increasingly active research direction has pursued the use of alternative modalities. For example, it is clear that data acquired using 3D scanners is inherently robust to illumination and pose changes. However, the cost of these systems is high and the process of data collection overly restrictive.

Facial Recognition System: A Review Ankita1 , Dr. Sanjay Kumar Malik2 1M. Tech Scholar, Hindu College of Engineering 2Assistant Professor, Hindu College of Engineering

Here, we are working with Face and Facial Biometric System. Facial biometric processing is one tool in the same direction. The survey on the face recognition is made in 1995 by R. Chellappa. But the analysis was started on the face in late 90‟s. A major work had been done till the end of 1990 on the face and the facial features. In earlier stages the faces are detected on the basis of distance analysis or its alignment position or the autocorrelation matrices. After that this work is forwarded with different technologies. A face biometric system has a lot of advantages and disadvantages.A facial system can be online or the offline system. It means we can perform the facial processing either from the image or we can extract the image from online means such as the Webcam. Such kind of system can be attached along with a web application that will accept the human face from webcam as the password to the system. A face can represent the human expressions and emotions clearly such as anger, cry, laugh. For each emotion the system will return an individual face image. We use facial system in such application

The face is the most visible feature of a human. It helps a user to identify any mistake of the computer based recognition system as the results can be verified by the user, i.e. the results given by pain recognition system can be verified by the doctor by observing the patient‟s face. Facial Biometric system has different applications according to the facial features. It can be used as an identification system for any application or any website. It can also be used as criminal identification system

The ancient Egyptians and the Chinese played a vital role in biometrics' history. Although biometric technology belongs to the twenty-first century, the history of biometrics goes back thousands years. Today, the focus is on using biometric recognition and identifying characteristics to improve security measures. Once an individual is matched against a template, or sample, in the database, a security alert goes out to the authorities. Biometric technologies also need to achieve greater standardization and technological innovations to be recognized as a trustworthy identity authentication solution. European recorded the first known example of fingerprinting, which is a form of biometrics, in China during the 14th century. Chinese merchants used ink to take children's fingerprints for identification purposes. In 1890, a Parisian police desk studied body mechanics and measurements to help in identification of criminals. In the 1960s and '70s, signature biometric authentication procedure was developed, but the biometric field remained fixed to the military and

security agencies research which developed biometric technology beyond fingerprinting. Biometrics is a growing and controversial field in which civil liberties groups express concern over privacy and identity issues. Today, biometric laws and regulations are in process and biometric industry standards are being tested. Face recognition biometrics has not only reached the prevalent level of fingerprinting, but the constant technological pushes and with the threat of terrorism, researchers and biometric developers will hone the security technology for the twenty-first century. Anil K. Jain, Arun Ross and Salil Prabhakar . Designed a Biometric Recognition system using the four main modules: 1. Sensor module, which captures the biometric data of an individual. 2. Feature extraction module, in which the acquired biometric data is processed to extract a set of salient or discriminatory features. 3. Matcher module, in which the features during recognition are compared against the stored templates to generate matching scores. 4. System database module, which is used store the biometric templates of the enrolled users. Weicheng Shen and Tieniu Tan have proposed a typical automated biometrics-based identification/verification system that consists of the following major components: 1. Data acquisition component acquires the biometric data in digital format by using a sensor. 2. Feature extraction component uses an algorithm to produce a feature vector in which the components are numerical characterizations of the underlying biometrics. The feature vectors are designed to characterize the biometrics so that biometric data can be collected from an individual, at different times that are similar, while those collected from different individuals are dissimilar. In general, the larger the size of a feature vector (without much redundancy), the higher will be its discrimination power which is defined as the difference between a pair of feature vectors representing two different individuals.

A Survey paper for Face Recognition Technologies Kavita , Ms. Manjeet Kaur **M.Tech.CSE, Riem, Rohtak ** Assistant Professor RIEM,Rohtak

Humans often use faces to recognize individuals and advancements in computing capability over the past few decades now enable similar recognitions automatically. Early face recognition algorithms used simple geometric models, but the recognition process has now matured into a science of sophisticated mathematical representations and matching processes. Major advancements and initiatives in the past ten to fifteen years have propelled face recognition technology into the spotlight. Face recognition can be used for both verification and identification (open-set and closed-set).

Face Recognition Processing Face recognition is a visual pattern recognition problem. There, a face as a three-dimensional object subject to varying illumination, pose, expression and so on is to be identified based on its two-dimensional image (three-dimensional images e.g., obtained from laser may also be used). A face recognition system generally consists of four modules

1. Face verification (or authentication) 2. Face identification (or recognition) In face verification or authentication there is a one-to-one matching that compares a query face image against a template face image whose identity is being claimed. In face identification or recognition there is a one-to-many matching that compare a query face image against all the template face images in the database to determine the identity of the query face image. Another face recognition scenario involves a watch-list check, where a query face is matched to a list of suspects (one-to-few matches). The performance of face recognition systems has improved significantly since the first automatic face recognition system was developed by Kanade (T.Kanade, 1973). Furthermore, face detection, facial Feature extraction, and recognition can now be performed in real-time for images captured under favorable (i.e. constrained) situations. Although progress in face recognition has been encouraging, but still there are some unconstrained tasks where viewpoint, illumination, expression, occlusion, accessories, and so on vary considerably. It is natural, nonintrusive, and easy to use. There are many biometric systems but among the six famous biometric attributes considered by Hietmeyer (R. Hietmeyer, 2000), In a Machine Readable Travel Documents (MRTD) system facial features scored the highest compatibility, such as enrollment, security system, machine requirements, renewal, surveillance system and public perception

LITERATURE SURVEY Face recognition has been an active research area over last 40 years. The face recognition research has several disciplines such as image processing, machine learning approach, pattern recognition, computer vision, and neural networks. Classification is the main problem. In the process of face recognition it includes, to train the face images from the known individuals and then to classify the newly coming test images into one of the classes. The problem of face recognition is easily solved by Humans where limited memory can be the main problem. The problems or limitations for a machine learning face recognition system are: 1. Facial expression change 2. Illumination variation 3. Ageing 4. Pose change 5. Scaling factor (i.e. size of the image) 6. Frontal vs. profile 7. Presence and absence of spectacles, beard, mustache etc. 8. Occlusion due to scarf, mask or obstacles in front.

Facial Recognition: Benefits and Challenges!

By: Navin Parti, Vice President, Q3 Technologies

With state-of-the-art technology giving full reins to wishful fantasies which we could only imagine in the world of fairy tales, our digital communication and its after-effects have revolutionized the way one thinks, works and behaves, not just at workplace, but at every step that governs our life. As technological advancement follows high-tech expertise and is seen percolating down to different echelons of society, it also reigns supreme and becomes the keyword, and has become a must for all businesses of all kinds to take on the growing challenges of newer digital areas. Keeping up with

such trends is the advent of Facial recognition, which uses AI & Machine Learning, and has worked wonders in the use of security systems and other biometrics, such as fingerprint or eye iris recognition systems, in addition to becoming extremely useful as a commercial identification and marketing tool.

By definition, a face recognition system is just another computer application that helps in identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a face database.

Resultantly, multifarious applications across numerous sectors like Retail, Healthcare, Government, Travel & Tourism and many other industries, have benefitted tremendously with the use of facial data for various applications. Combined with the stupendous growth in population and the common man getting access to what was hitherto a reserve for the affluent, the functions of facial data seem to have magnified its strengths to unlimited usage.

With competition adding more zing to make devices cheaper, the consequences could extend to other recognition algorithms, such as, 3-dimesional recognition, Thermal cameras and Skin Texture analysis, to name a few.

Besides security systems, many governments have gained using a number of other applications for face recognition systems, but because of their covert nature, many such deployments are not in the public domain. Suffice it to say that every authority- be it the government or a corporate house to even institutions – earns rich dividends that go a long way to establish them as an incredibly data-rich law-enforcement and security agency, with a wide remit for data collection.

Although concerns about biometric data used in fingerprint and facial recognition systems are unavoidable because it is indelible, and is being used in authoritative identity registers, and is featured on identity documents such as passports and driver licenses, by 2020, the facial recognition software market will reach $6 billion worth. With the help of smartphones, major giants like MasterCard and Facebook – using predictive intelligence – have used selfie payments and tagging features respectively. Snapchat’s geo filters and special facial recognition effects are also aimed in this direction.

If we take a closer look at other areas, viz., industries where more innovative applications could determine the course of action and assist in going forward, we could look at the ramifications it may have:

Government/ Identity Management

The governments in Australia have built large biometric databases through registration of people as drivers with a photograph of the driver through registration for passports, aviation/maritime security and other purposes.

The U.S. Department of State with 117 mn American adults in its database is one of the largest face recognition systems in the world.

For general management and running one can use these systems for census studies, voter identification, census studies, healthcare interventions, BPL handouts, law and order management etc. Particularly in a country like India with all its diversity, where there may not be a coherent enforceable right to privacy, this application could have far-reaching significance. But, with a rider, that it is judiciously and effectively implemented.

3D face recognition: a survey

- **Song Zhou & Sheng Xiao**

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Acquired 3D face data cannot be directly used as the inputs of feature extraction algorithms because the data contain the human faces, but also many distracting features such as hair, ear, neck, eye glasses, and jeweleries. It is true that when us human beings identify each other, these features could be helpful. However, computers are not as intelligent as us at least for now. Features like hair, eye glasses, and jeweleries could be Research in face recognition can be dated back to 1960s . From 1964 to 1966 Woodrow W. Bledsoe, along with Helen Chan and Charles Bisson of Panoramic Research, researched programming computers to recognize human faces. Their program asks the administrator to locate the eyes, ears, nose and mouth in the photo. Then, the reference data can be use comparison with the distance and measures. However, because of inconvenience, this work has not received much recognition. Peter Hart at the Stanford Research Institute continued this research, and found optimistic results when using a set of images instead of a set of feature points. Since then, there have been many researches following on this subject and a substantial amount of efforts have been made to find the optimal face recognition method. In the 1970s, Goldstein, Harmon, and Lesk used 21 specific subjective markers such as hair color and lip thickness to automatically identify human faces. The attempt obtained good recognition accuracy. However, the feature measurement and locationing are manually calculated. It is impractical to apply this method to many faces. In 1991, Turk and Pentland proposed a method of using principal component analysis (PCA) to handle face data . This is called the eigenface algorithm which is already become a golden standard for face recognition. Later, inspired by eigenface, a large number of such algorithms were proposed .

In 1997, Christoph von der Malsburg designed a system that can identify people in photos when the photos are not clear. Followed this work, the research of face recognition diverged into two paths. Face recognition by 3D view is proposed and implemented in systems such as Polar and FaceIt.

Although 2D face recognition has achieved considerable success, but the accuracy is still significantly affected by changes in pose and illumination conditions . Many researchers have turned to 3D face recognition because its potential capabilities to overcome the inherent limitations and drawbacks of 2D face recognition. Moreover, the geometric information provided by 3D face data may result in higher recognition accuracy than the 2D case when the pose and illumination conditions are the same.

In the late 1980s, used curvature-based methods to test on a small 3D face database, and reached 100% recognition accuracy. In 1996, Gordon's face recognition experiments showed that combining frontal and side views can improve the recognition accuracy . After that, more and more 3D face recognition research has been proposed, becuase of the increasing availability of 3D scanning equipments (mainly based on laser and structured light technology).

In 2012, deep learning was first used to analyze and process three-dimensional face images for face recognition . Compared with the traditional method, Deep Convolutional Neural Networks (DCNN) has a great advantage in the processing of image and video, whereas Recurrent Neural Network (RNN) also shows a very good performance in processing continuous data such as voice and text . By using deep learning to train large-scale face datasets, the recognition accuracy of 2d face recognition has been significantly improved . The method of deep learning needs to large datasets to learn face features and be able to depict rich internal information of data. Large-scale 2D face datasets can be obtained from the Internet. Compared 2D face dataset, training discriminative deep features for 3D face recognition is very difficult due to the lack of large-scale 3D face datasets . In order to solve this problem, Kim et al. proposed using the existing trained 2D face model, and adjust a small amount of 3D face datasets to 3D surface matching. Also, proposed a method for generating a large corpus of labeled 3D face identities and their multiple instances for training and a protocol for merging the most challenging existing 3D datasets for testing. They also proposed the first deep CNN model designed specifically for 3D face recognition and trained on 3.1 million 3D facial scans of 100,000 identities. The proposed training and test datasets are several orders of magnitude larger than previously existing 3D datasets reported in the literature. Based on the 3D datasets, FR3DNet algorithm has been proposed and achieved great accuracy in closed and open world recognition scenarios .

In, many identification techniques were surveyed. Face recognition can be divided into three categories based on feature extraction methods used in the identification process: global approach, component-based approach and hybrid approach. In the global approach, the entire face is used as a

single feature vector for feature classification. The component-based approach mainly analyzes the local facial features such as nose and eyes. The hybrid approach uses both global and local features. The hybrid approach is very effective when the face is frontal and the expression does not change.

- head poses. These features could be misleading to the current state-of-the-art 3D face recognition algorithms and therefore should be removed before feature extraction.
- The first step of preprocessing is to detect the position and orientation of human face. Geometric transformations are used to "turn" the human face to directly against the camera axis. Then the preprocessing uses the help from clearly identifiable facial parts such as nose to isolate the human face area out from areas of the distracting features. This operation is called segmentation.
- The preprocessed facial data samples are often interpreted in three model formats: depth image, corresponding to the three popular 3D scanners. They are formats to represent 3D face data.
- Feature extraction, feature database, and feature matching
- The most straightforward school of feature extraction is to take the entire face as a single feature vector, which is called the global approach. In this approach, the entire face is stored in the database. In the feature matching stage, the target face is compared with faces in database using statistical classification functions . Opposed to the global approach, the component based approach focuses on the local facial characteristics such as nose and eyes. It uses graph operators to extract the nose and eyes part and store these local features in the database. When a target face is inputed for recognition, the component based approach first extract the corresponding parts from the target faces and then searching the matched set of parts from the feature database . There are hybrid approaches that combine the features used by the global approaches and the local approaches. With more computational cost, the hybrid approach could achieve better recognition accuracy.

Face recognition: A literature survey

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As one of the most successful applications of image analysis and understanding, face recognition has recently received significant attention, especially during the past several years. At least two reasons account for this trend: the first is the wide range of commercial and law enforcement applications, and the second is the availability of feasible technologies after 30 years of research. Even though current machine recognition systems have reached a certain level of maturity, their success is limited by the conditions imposed by many real applications. For example, recognition of face images acquired in an outdoor environment with changes in illumination and/or pose remains a largely unsolved problem. In other words, current systems are still far away from the capability of the human perception system. This paper provides an up-to-date critical survey of still- and video-based face recognition research. There are two underlying motivations for us to write this survey paper: the first is to provide an up-to-date review of the existing literature, and the second is to offer some insights into the studies of machine recognition of faces. To provide a comprehensive survey, we not only categorize existing recognition techniques but also present detailed descriptions of representative methods within each category. In addition, relevant topics such as psychophysical studies, system evaluation, and issues of illumination and pose variation are covered.

CHAPTER – 3
AIMS AND OBJECTIVES

Aim: Facial recognition by using MATLAB.

Objective:

- Face detection in images
- Real- time face detection
- Face detection process
- Face recognition difficulties

Materials Required:

Hardware requirements:

- Laptop and Webcam.
- I386 0r higher processor can be used.
- A minimum of 32mb RAM is required.
- A hard disk of not less than 2 GB is supported.
- Software requirements:
- MATLAB R2019

CHAPTER-4

METHODOLOGY

- Initially download the trial version of the software MATLAB.
- Where the downloading of the software will taking time for the download of its product toolkits for the purpose of analysis as follows:
- Computer version toolbox 9.1
- Image acquisition toolbox 6.1
- Image processing toolbox 11.0
- Mapping toolbox 4.9
- Parallel computing toolbox 7.1
- Signal processing toolbox 8.3
- Statistics and machine learning toolbox 11.6

Face detection using MATLAB system testing

FACE DETECTION IN IMAGES:

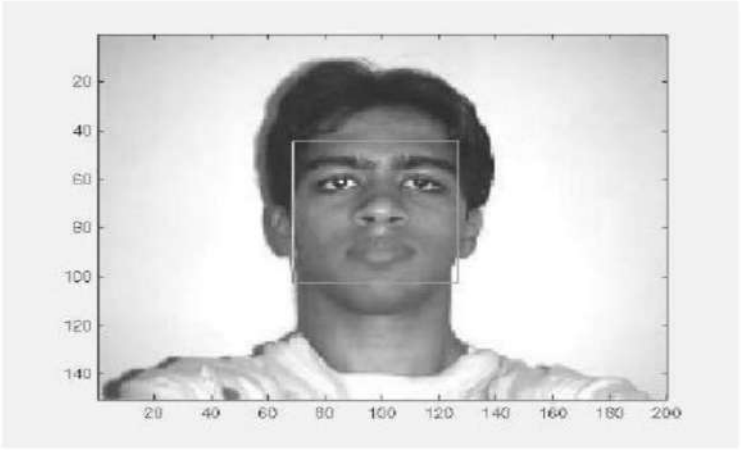


Figure 1: A successful face detection in an image with a frontal view of a human face

Most face detection systems attempt to extract a fraction of the whole face, thereby eliminating most of the background and other areas of an individual's head such as hair that are not necessary for the face recognition task. With static images, this is often done by running a across the image. The face detection system then judges if a face is present inside the window. With static images there is a very large search space of possible locations of a face in an image.

A neural network or some other classifier is trained using supervised learning with 'face' and 'nonface' examples, thereby enabling it to classify an image (window in face detection system) as a 'face' or 'non-face'. while it is relatively easy to find face examples, how would one find a

representative sample of images which represent non-faces (Rowley et al., 1996)? Therefore, face detection systems using example based learning need thousands of 'face' and 'nonface' images for effective training.

REAL TIME FACE RECOGNITION:

Real-time face detection involves detection of a face from a series of frames from a videocapturing device. From a computer vision stand point, real-time face detection is actually a far simpler process than detecting a face in a static image. This is because unlike most of our surrounding.

Figure 2: Image from one frame from an video

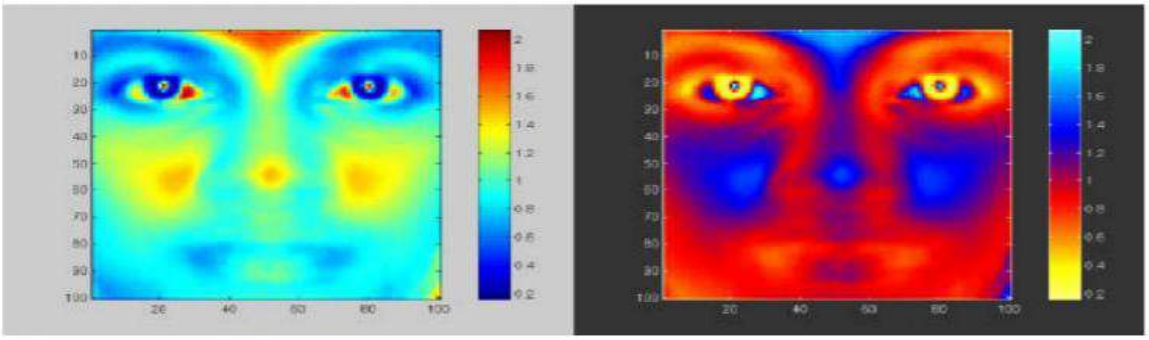
Figure 3: Image from another frame from an video

Figure 4: Spatio-Temporally filtered image

Since in real-time face detection, the system is presented with a series of frames in which to detect a face, by using spatio-temperal filtering (finding the difference between subsequent frames), the area of the frame that has changed can be identified and the individual detected.

FACE DETECTION PROCESS

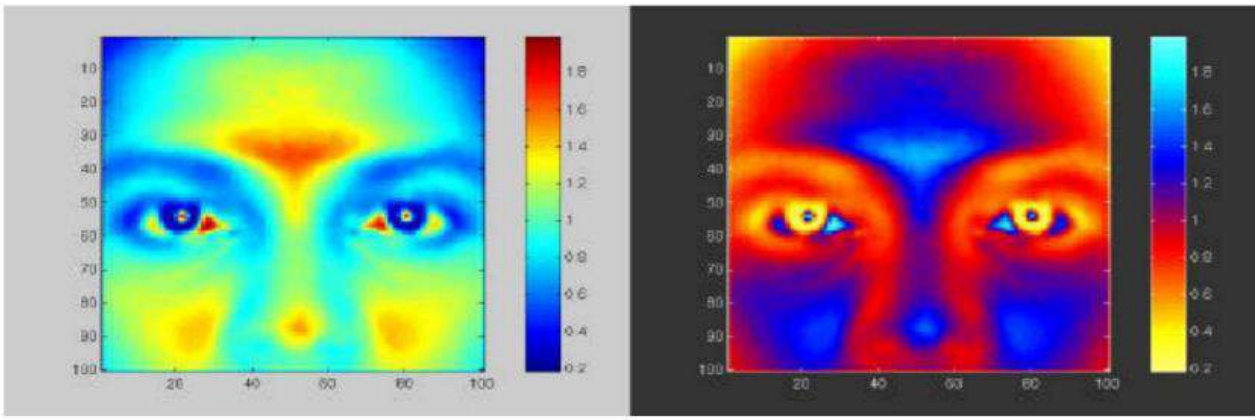
It is process of identifying different parts of human faces like eyes, nose, mouth, etc… this process can be achieved by using MATLAB code. In this the attempt to detect faces in still images by using image invariants. To do this it would be useful to study the greyscale intensity distribution of an average human face. The following 'average human face' was constructed from a sample of 30 frontal view human faces, of which 12 were from females and 18 from males. A suitably scaled colormap has been used to highlight grey-scale intensity differences.



Scaled colourmap **Scaled colourmap(negative)**

Figure 5:Average human face in grey-scale

The grey-scale differences, which are invariant across all the sample faces are strikingly apparent. The eye-eyebrow area seem to always contain dark intensity (low) gray-levels while nose forehead and cheeks contain bright intensity (high) grey-levels. The following areas of the human face were suitable for a face detection system based on image invariants and a deformable template.



Scaled colourmap **scaled colourmap(negative)**

Figure 6: Area chosen for face detection (indicated on average human face in gray scale)

The above facial area performs well as a basis for a face template, probably because of the clear divisions of the bright intensity invariant area by the dark intensity invariant regions. Once this pixel area is located by the face detection system any particular area required can be segmented based on the proportions of the average human face.

Face Recognition Difficulties:

1. Identify similar faces (inter-class similarity)

2. Accommodate intra-class variability due to

2.1 head pose

2.2 illumination conditions

2.3 expressions

2.4 facial accessories

2.5 aging effects

3. Cartoon faces

CHAPTER-5

RESULT AND CONCLUSION

RESULT

Matlab is used to identify the images from the photographs and also realtime images from a video of a person. Even through the person is wearing and accessories matlab software is able to identify the person with the help of grey scale measure.

CONCLUSION

Today most non-enthusiast digital cameras easily have a minimum of 5 megapixel and new cameras are often sold with resolutions approaching 10 megapixel. Given these extreme figures it seems very safe to use a higher starting scale. Add to this, that if the face detector is to be succeeded by a recognition system a certain minimum face size is required in order to make a successful extraction of facial features.

The fully automated face detection and recognition system was not robust enough to achieve a high recognition accuracy. The only reason for this was the face recognition subsystem did not display even a slight degree of invariance to scale, rotation or shift errors of the segmented face image.

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