© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 07 Issue: 04 | July – September 2016
Paper is available at www.jrps.in | Email : info@jrps.in

Review on impact of Face Recognition Technology in Biometrics

[1]MANJU BALA, Department- Computer Science Engg., : Choudhary Devilal University Sirsa
[2]Kapil Kaswan, Assistant professor, Department- Computer Science Engg., : Choudhary Devilal University Sirsa

Abstract: *Proposed research gives pilot results of project that is oriented on use of Neural Network in Face recognition. Biometrics is the technology of identifying uniquely human subjects by means of measuring and analyzing one or more intrinsic behavioral or physical traits. These human body characteristics include fingerprints, voice patterns, eye retinas and irises, facial patterns and hand measurements. Neural networks have been successfully applied in a wide range of supervised and unsupervised learning applications. Neural-network methods are not commonly used for data-mining tasks, however, because they often produce incomprehensible models and require long training times. We have integrated Neural-Network in this research with Biometric technique known as Face Recognition.*

Keywords: Biometrics, Simulation, Neural Network, Matlab, Face Recognition, Physical Traits

[I] INTRODUCTION

Biometrics is the technology of identifying uniquely human subjects by means of measuring and analyzing one or more intrinsic behavioural or physical traits. These human body characteristics include fingerprints, voice patterns, eye retinas and irises, facial patterns and hand measurements. Biometric systems include applications making use of biometric technologies and which allow the identification automatically, verification or authentication of a natural person.

Neural networks were started about 50 years ago. Their early abilities were exaggerated, casting doubts on the field as a whole there is a recent renewed interest in the field, however, because of new techniques and a better theoretical understanding of their capabilities. Neural networks have been successfully applied in a wide range of supervised and unsupervised learning applications. Neural-network methods are not commonly used for data-mining tasks, however, because they often produce incomprehensible models and require long training times.

Automatic recognition of human faces represents a major challenge to pattern recognition research community. From person to person human faces are similar in structure with minor differences. They are actually within one class of human face. Facial expressions, Lighting condition changes & pose variations further complicate face recognition task because one of complex problems in pattern analysis. Research proposed a unique concept faces may be recognized using Neural Network. To speed up searching process face prefiltering technique is proposed. Investigation on proposed concept is conducted that covers all aspects on human face recognition, for example face recognition, under controlled & size variation, ideal condition, manipulating facial expression, manipulating lighting condition & manipulating pose.

[II] SOFT COMPUTING

In computer science, **soft-computing** is use of inexact solutions to computationally hard tasks like solution of NP-complete problems, for which there is no known algorithm that may compute an exact solution in polynomial time. Soft-computing is different from conventional (hard) computing in that, unlike hard computing, it is tolerant of uncertainty, imprecision, partial truth, & approximation. In effect, role model for soft computing is human mind.

Soft-computing solutions are considered unpredictable and uncertain, & between 0 & 1. Soft Computing became a formal area of study in Computer Science in early 1990s. Earlier computational approaches could model & precisely analyze only relatively simple systems. Complex systems arising in biology, humanities, medicine, management sciences, & similar fields remained intractable to conventional mathematical & analytical methods. It should be pointed out that simplicity & complexity of systems are relative, & many conventional mathematical models have been both challenging & very productive. Soft computing deals with uncertainty, imprecision, partial truth & approximation to achieve practicability, robustness & low solution cost. As such it forms basis of a considerable amount of machine learning techniques/technology. Recent trends tend to involve evolutionary & swarm intelligence based algorithms

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& bio-inspired computation. There are main difference between soft-computing & possibility. Possibility is used when we do not have enough information to solve a problem but soft-computing can be used when we do not have enough information about problem itself. These kinds of problems originate in human mind with its doubts, subjectivity & emotions; an example may be determining a suitable temperature for a room to make people feel comfortable.

Components

Components of soft-computing are:

1. Neural networks (NN)
    a. Perceptron
2. Support Vector Machines (SVM)
3. Fuzzy logic (FL)
4. Evolutionary computation (EC), including:
    a. Evolutionary algorithms
        i. Genetic algorithms
        ii. Differential evolution
    b. Metaheuristic & Swarm Intelligence
        i. Ant colony optimization
        ii. Particle swarm optimization
        iii. Firefly algorithm
        iv. Cuckoo search
5. Ideas about probability including:
    a. Bayesian network
6. Chaos theory

Soft-computing techniques/technology resemble biological processes more closely than traditional techniques/ technology, which are largely based on formal logical systems, such as sentential logic & predicate logic and rely heavily on computer aided numerical analysis as in finite element analysis. Soft computing techniques/technology are intended to complement each other.

Unlike hard computing schemes, which strive for exactness & full truth, soft computing techniques/technology exploit given tolerance of imprecision, partial truth, & uncertainty for a particular problem. Another common contrast comes from observation that inductive reasoning plays a larger role in soft computing than in hard computing.

[III] AREA OF RESEARCH

Bioinformatics & Biomedicine

SC has attracted close attention of researchers & has also been applied to solve problems in bioinformatics & biomedicine. Nevertheless, amount of information from biological experiments & applications involving large-scale high-throughput technologies is rapidly increasing nowadays. So, the ability of being scalable across large-scale problems becomes an essential requirement for modern SC approaches.

Neural Network

Neural networks have been successfully applied in a wide range of supervised and unsupervised learning applications. Neural-network methods are not commonly used for data-mining tasks, however, because they often produce incomprehensible models and require long training times. There are two classes of approaches for data mining with neural networks. The first type of approach, often called rule extraction, involves extracting symbolic models from trained neural networks. The second approach is to directly learn simple, easy-to-understand networks.

Biometrics

Biometrics is the technology of identifying uniquely human subjects by means of measuring and analyzing one or more intrinsic behavioral or physical traits. These human body characteristics include fingerprints, voice patterns, eye retinas and irises, facial patterns and hand measurements. Biometric systems include applications making use of biometric technologies and which allow the identification automatically, verification or authentication of a natural person. In principle, the processing of personal data involving the use of a biometric system is considered by privacy experts to be only justified in places demanding a high level of security and strict identification procedures.

The implementation of similar systems should occur in a transparent manner and therefore appropriate information should always be provided to employees. Where the introduction of biometric systems is necessary, employers should opt for that system which provides a high level of comfort in terms of the privacy requirements. It is possible in view of the technological progress achieved in this field.

[IV] WORKING PRINCIPLE

During the enrolment phase, the data is immediately converted into a template containing a unique binary code which represents the characteristics or measurements of the biometric feature. This binary

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code is normally encrypted and kept in a separate storage space, for instance, in the memory of the biometric device. In this way the biometric data is segregated from other personal information conventionally contained in a back-end database and kept for administrative purposes.

For instance, every time the person makes use of the biometric device to enter or exit the work premises, the system will convert the fingerprint data to a binary code and match the code with the one previously contained during the enrolment phase to authenticate the individual.

The method of identification based on biometric characteristics is preferred over traditional passwords and PIN based methods for various reasons such as: The person to be identified is required to be physically present at the time-of-identification. Identification based on biometric techniques obviates the need to remember a password or carry a token. A biometric system is essentially a pattern recognition system which makes a personal identification by determining the authenticity of a specific physiological or behavioural characteristic possessed by the user. Biometric technologies are thus defined as the "automated methods of identifying or authenticating the individuality of a living person based on a physiological or behavioral characteristic".

Identification - One to Many: Biometrics can be used to determine a person's individuality even without his knowledge or consent. For example, scanning a crowd with a camera and using face recognition technology, one can determine matches against a known database.

Verification - One to One: Biometrics can also be used to verify a person's individuality. For example, one can grant physical access to a secure area in a building by using finger scans or can grant access to a bank account at an ATM by using retinal scan.

Biometric authentication requires to compare a registered or enrolled biometric sample (biometric template or identifier) against a newly captured biometric sample.

All biometric systems use common main functional components, which include:

- **Storage entity** with the biometric data samples (templates) of the enrolled individuals that is linked or integrated in a database with the individuality information of the corresponding individuals.
- **Biometric sensor device** and pre-processing capacities to capture the biometric sample data from an individual as input data.
- **Comparison process** evaluating the similarity between reference template and captured data sample and then calculating a matching score.
- **Decision function** that decides if the data sample matches the reference template.

[V] FACE RECOGNITION SYSTEM

Face recognition system is one of the biometric system that has been used for security purposes in bank ATM, Examination hall and different security Agencies. Automatic recognition of human faces represents a major challenge to pattern recognition research community. From person to person human faces are similar in structure with minor differences. They are actually within one class of human face. Facial expressions, Lighting condition changes & pose variations further complicate face recognition task because one of complex problems in pattern analysis. Research proposed a unique concept faces may be recognized using Neural Network. To speed up searching process face prefiltering technique is proposed. Investigation on proposed concept is conducted that covers all aspects on human face recognition, for example face recognition, under controlled & size variation, ideal condition, manipulating facial expression, manipulating lighting condition & manipulating pose.

[VI] MOTIVATION & PROBLEM STATEMENT

The Face Recognition biometric has a low data collection error rate and high user acceptability. Further, **Face Recognition** technology has had the most research and development money applied to both identification and authentication problem. Finally, **Face Recognition** biometrics has the highest acceptance in the identification community and virtually every large biometrics system in operation today uses **Facial expressions** biometrics. Notwithstanding it's association with "criminal" applications, facial expression biometrics is generally accepted by clients.

For Security: Protect Sensitive Data, High degree of individuality certainty in transactions and Create databases with singular identities

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For Accountability: Improve auditing / reporting / record keeping and Time keeping and For Efficiency. Reduce password-related problems. It is also used in following areas.

- Enterprise-wide network security infrastructures
- Secure electronic banking, investing and
- Other financial transactions like
    - Retail sales.
    - Law enforcement.
    - Health & Social services.

Neural networks were started about 50 years ago. Their early abilities were exaggerated, casting doubts on the field as a whole There is a recent renewed interest in the field, however, because of new techniques and a better theoretical understanding of their capabilities.

Motivation for neural networks:

- Scientists are challenged to use machines more effectively for tasks currently solved by humans.
- Symbolic Rules don't reflect processes actually used by humans
- Traditional computing excels in many areas, but not in others.

[VII] LITERATURE REVIEW

Line-Based Face Recognition under Varying Pose by Olivier de Vel & Stefan Aeberhard IEEE TRANSACTIONS ON PATTERN ANALYSIS & MACHINE INTELLIGENCE, VOL. 21, NO. 10, OCTOBER 1999

Image-based face recognition algorithm is proposed that uses a set of random rectilinear line segments of two dimensional face image views because underlying image representation together with closest neighbor classifier as line matching scheme. Mixture of one Dimensional line segments exploits inherent coherence in one or more two dimensional face image views in viewing sphere. Algorithm achieves high generalization recognition rates for rotations both in & out of plane, & is computationally efficient, is robust to scaling. Results proves that categorization accuracy of proposed algorithm is superior compared with benchmark algorithms. Research in human face recognition consists of fronto-parallel face images constrained rotations in & out of plane, & operates under strict imaging conditions like controlled illumination & limited facial expressions.

Face & View Recognition Performance Results

They ran two sets of experiments using optimal parameter values. They selected training set by inspection in order to provide a good cover of varying head positions & facial expressions. In second set of experiments, they randomly selected image views, repeating process three times. They expect to obtain an inferior recognition rate for random sampling of training set compared with selected sampling.

Most real-world applications would allow selecting good training views, as with our first approach. However, in some applications such as video sequences, random sampling is more realistic. They also evaluated algorithm for both face recognition & view recognition. That is, in former case, algorithm is presented with all test image views for a given face, whereas, in latter case, algorithm is presented with just a single test view.

They expect lower recognition performance results for view recognition as compared with face recognition.

Face Recognition Using Line Edge Map by Yongsheng Gao, Member, IEEE, & Maylor K.H. Leung, Member, IEEE TRANSACTIONS ON PATTERN ANALYSIS & MACHINE INTELLIGENCE, VOL. 24, NO. 6, JUNE 2002

Research proposed a unique concept faces may be recognized using line edge map. A compact face feature, Line Edge Map is generated for face coding & recognition. To speed up searching process face prefiltering technique is proposed. Investigation on proposed concept is conducted that covers all aspects on human face recognition, for example face recognition, under controlled & size variation, ideal condition, manipulating facial expression, manipulating lighting condition & manipulating pose. Performance of system are compared with eigenface method a face recognition techniques & reported experimental results of various methods.

LINE EDGE MAP

Cognitive psychological studies indicated that human beings recognize line drawings as quickly & almost as accurately as gray-level pictures. These results may imply that edge images of objects can be used for object recognition & to achieve similar accuracy as gray-level images. Takacs made use of edge maps, which was motivated by above finding, to measure similarity of face images. faces were encoded into

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binary edge maps using Sobel edge detection algorithm. Hausdorff distance was chosen to measure similarity of two point sets for example edge maps of two faces, because Hausdorff distance can be calculated without explicit pairing of points in their respective data sets.

A unique face feature representation, Line Edge Map is proposed here to integrate structural information with spatial information of a face image by combining pixels of face edge map to line segments. After thinning edge map, a polygonal line fitting process is applied to generate LEM of a face. LEM representation, that records only end points of line segments on curves, further reduces storage requirement. Efficient coding of faces is important aspect in a face recognition system. LEM is considered to be less sensitive to illumination changes because of fact that it is an intermediate level image representation derived from low level edge map representation. Basic unit of LEM is line segment grouped from pixels of edge map.

Biometrics and Face Recognition Techniques by Renu Bhatia ***Department of Computer Science and Applications Kurukshetra University, Kurukshetra Haryana, INDIA***

Biometrics is a growing technology, which has been widely used in forensics, secured access and prison security. A biometric system is fundamentally a pattern recognition system that recognizes a person by determining the authentication by using his different biological features i.e. Fingerprint, retina-scan, iris scan, hand geometry, and face recognition are leading physiological biometrics and behavioral characteristic are Voice recognition, keystroke-scan, and signature-scan. In this paper different biometrics techniques such as Iris scan, retina scan and face recognition techniques are discussed.

Image-based Face Detection and Recognition: "State of the Art" by Faizan Ahmad, Aaima Najam and Zeeshan Ahmed

Face recognition from image or video is a popular topic in biometrics research. Many public places usually have surveillance cameras for video capture and these cameras have their significant value for security purpose. It is widely acknowledged that the face recognition have played an important role in surveillance system as it doesn't need the object's cooperation. The actual advantages of face based identification over other biometrics are uniqueness and acceptance. As human face is a dynamic object having high degree of variability in its appearance, that makes face detection a difficult problem in computer vision. In this field, accuracy and speed of identification is a main issue. The goal of this paper is to evaluate various face detection and recognition methods, provide complete solution for image based face detection and recognition with higher accuracy, better response rate as an initial step for video surveillance. Solution is proposed based on performed tests on various face rich databases in terms of subjects, pose, emotions, race and light.

[VIII]TOOLS & TECHNOLOGY USED

HARDWARE

- CPU 1Ghz or more
- HARDDISK (5GB Free space)
- DVD ROM
- MONITOR (HIGH RESOLUTION)
- KEYBOARD/MOUSE

SOFTWARE

- WINDOWS 7/8
- MATLAB
- DOT NET FRAMEWORK

Computational neurobiologists have constructed very elaborate computer models of neurons in order to run detailed simulations of particular circuits in the brain. As Computer Scientists, we are more interested in the general properties of neural networks, independent of how they are actually "implemented" in the brain. This means that we can use much simpler, abstract "neurons", which (hopefully) capture the essence of neural computation even if they leave out much of the details of how biological neurons work.People have implemented model neurons in hardware as electronic circuits, often integrated on VLSI chips. Remember though that computers run much faster than brains - we can therefore run fairly large networks of simple model neurons as software simulations in reasonable time. This has obvious advantages over having to use special "neural" computer hardware.

[IX] OBJECTIVE OF RESEARCH

Investigation on proposed concept is done that covers all aspects on human face recognition, for example face recognition, under controlled & size variation, ideal condition, manipulating facial expression, manipulating lighting condition & manipulating pose using Neural network.

Pattern recognition, i.e. recognizing handwritten characters features of Neural network has been used in face recognition.
The objective of research is to use multilayer neural network to implement Face Recognition. In order to overcome the limitation of existing faces recognition system the pros of neural network algorithm has been merged.

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