Course Overview:

As security continues to be a major concern for today's society, a reliable means of personal identification is required by commercial, law enforcement and physical access control applications. Previously, an individual's identity was established utilizing knowledge of a piece of information (password) or the possession of an item (ID card). These methods are subject to circumvention through unauthorized sharing or misplacement. Because of this, biometrics is a far superior approach to personal identification. Biometrics is the science of identifying or authenticating an individual's identity based on behavioral or physiological characteristics. Government Ids, secure electronic banking, retail sales, and health and social services all have benefited from the use of biometric technology and will continue to do so as biometric research advances.

Introduction of Biometric traits and its aim, image processing basics, basic image operations, filtering, enhancement, sharpening, edge detection, smoothening, enhancement, thresholding, localization. Fourier Series, DFT, inverse of DFT. Biometric system, identification and verification. FAR/FRR, system design issues. Positive/negative identification. Biometric system security, authentication protocols, matching score distribution, ROC curve, DET curve, FAR/FRR curve. Expected overall error, EER, biometric myths and misrepresentations. Selection of suitable biometric. Biometric attributes, Zephyr charts, types of multi biometrics. Verification on multimodel system, normalization strategy, Fusion methods, Multimodel identification. At the end of the course, students should be able to implement and apply the theory and concepts of data structure in the mini project which is conducted in group.

Course Aims

This course introduces students to the basic principles and methods used for biometric identification.

- The objective is to provide students with the scientific foundations needed to design, implement, and evaluate large scale biometric identification systems.

- The course will give students an advanced understanding of the requirements and technologies of Biometrics and Recognition.

- Train Masters graduates with an awareness, knowledge and computational skills in the field of Biometrics and Recognition.

- The course we will study the theory and applications of various biometric systems, performance and algorithms based on face, fingerprints voice, iris, and other modalities.

Pre-requisites and Co-requisites

- Basic Mathematics – Knowledge and ability to use calculus, probability, and statistics are essential.

- Programming Skills – The student should have experience in a high level programming language such as Pathon, Matlab or C/C++.

Course Instructor

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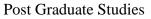
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References

- Biometrics: Theory, Methods, and Applications. Edited by Boulgouris, Plataniotis, and Micheli-Tzanakou, 2010
- Introduction to Biometrics By : Anil K. Jain, **Ross**, Arun A., **Nandakumar**, Karthik, 2011.
- Implementing Biometric Security By John Chirillo, Scott Blaul, 2003.
- Biometric Authentication by Virginio Cantoni Dimo, Dimov Massimo Tistarelli, Springer, 2014.
- Biometric Authentication: A Machine Learning Approach (paperback) (Prentice Hall Information and System Sciences Series) 1st Edition, by S.Y. Kung (Author), M.W. Mak (Author), S.H. Lin
- Advanced Biometric Technologies Edited by Girija Chetty and Jucheng Yang, 2016.
- Biometric Security and Privacy Opportunities & Challenges in The Big Data Era **By** Editors: Jiang, R., Al-Madeed, S., Bouridane, A., Crookes, D., Beghdadi, A. (Eds.), 2017

Topics

Implicit in a topic is the standard analysis of the relevant algorithms. We have omitted the traditional storage management material.

1. **General concepts**

- History & Overview of Biometrics.
- Definitions, biometric modalities, basic applications, access control, security
- Biometric applications

2. **Image Processing for Biometric Applications**

- Image processing basic: what is image, acquisition, type, point operations, Geometric transformations.
- Linear interpolation, brightness correction, histogram.
- Basic image operations: Convolution, linear/non-linear filtering, Guassian, Median, Min, gray level reduction.
- Special filters, enhancement filter, Edge detection, derivatives, Laplacian, un sharp masking, high boot filtering, sharpening special filtering, Edge detection.
- Canny edge detection, Fourier Series, DFT, inverse of DFT.

3. Biometric System Architecture

- Scanning/digitising,
- Enhancement,
- Feature extraction,
- Classification,
- Mmatching,
- Searching and Verification.

4. Eigen vectors and values

- Probability, statistics and estimation
- Random variables, discrete and continuous distribution
- Pattern classification and recognition
- Signals in time and frequency domain
- Multivariate statistical analysis.

5. Identification/verification

- Identification/verification,
- Threshold,Score distribution,
- FAR/FRR,System design issues.
- Positive/negative identification,
- Biometric system security,
- Authentication protocols,
- Authentication methods.
- Matching,
- Error type I/II,
- Matching score distribution,
- FM/FNM, ROC curve, DET curve, FAR/FRR curve.

6. Algorithms

- Face recognition
- Voice Recognition
- Fingerprint Recognition
- Iris Recognition Breadth and depth first searches
- Connectivity algorithms

7. Other biometric modalities:

- Retina,
- Signature,
- Hand geometry,
- Ggait,
- Keystroke
- Ear and Iris recognition, why ear, image acquisition, cropping ear and iris, normalization, matching and decision.

8. Multimodal Biometric systems

- Biometric system integration,
- Multimodal biometric systems: theory and applications,
- Performance evaluation of multimodal biometric systems.
- Biometric system vulnerabilities, circumvention, covert acquisition, quality control, template generation, interoperability, data storage.

9. Biometric System Security:

- Biometric attacks/tampering; solutions;

- Biometric encryption;

- Cancellable biometrics.
- Privacy and ethical issues

10. Biometric Application

Discussion the main application of Biometric in modern system such as Cloud computing, Green computing, and Mobil device.