# EEL 851: Biometrics

Ajay Kumar

Department of Electrical Engineering

IIT Delhi

# EEL 851

- ➢ Lecture Schedule:
  - Monday (II 337, 17:00-18:30 Hrs)
  - Thursday (II 337, 17:00-18:30 Hrs)

- ➢ Course Website:
  http://paniitd.ac.in/~ajaykr/biometrics/eel851.htm
  - Lecture materials
  - Assignments
  - Online References and Links

- ➢ Teaching Assistance:
  - Mr. Shubham Mankhand
  - Email: *shubham_mankhand@yahoo.com*

# Who Am I?

- ➤ Research:
  - ■ Computer Vision, Pattern Recognition
  - ■ Biometrics and Vision-based Industrial Inspection
- ➤ Electrical Engineering
- ➤ Office: 202 Block II
- ➤ Email: ajaykr@ieee.org
- ➤ Office hours: by appointment via email

# Course Outline

➢ **Objectives**

- To understand the state-of-the-art in biometric technologies;

- To survey the currently available biometric systems;

- To explore ways to improve some of the current techniques;

- To learn and implement some of the biometrics authentication;

- To explore new techniques;

➢ Textbooks and References

- A. Jain, R. Bolle, S. Pankanti, (Ed.), *BIOMETRICS: Personal Identification in Networked Society* , Kluwer Academic Publishers, 1999. ISBN 0-7923-8345-1. TK7882.P3 B36

- J. Ashbourn, *Biometrics: Advanced Identity Verification*, Springer-Verlag, 2000. ISBN 1-85233-243-3. TK7882.P3 A84

- Other Research Papers (details/copies will be provided in class)

# EEL 851

- An application oriented course
  - Not a tough course
  - Projects for hands on experience
- A computer science course
  - Must know if you claim to be a computer scientist
  - Multifaceted Applications, *e*-security and commerce
  - Essential for many follow up materials

# Course Contents

- An Overview of Biometrics
- Existing Biometric Technologies
  - Fingerprints
  - Face
  - Iris
  - Hand Geometry
  - Palmprint
  - Ear, Voice, Retina, …
- Performance Evaluation and Comparison of Biometrics
  - Performance Measures
  - Reliability, Uniqueness and Comparison
- Multimodal Biometric Authentication
  - Types of Fusion
  - Score Normalization
  - Intramodal and multimodal fusion, Strategies
- Biometric Security
  - Anti-Spoofing Measures
  - Liveness Detection
- Issues of Privacy
  - Public Concerns
  - Research Issues in personal Identification

# Course Prerequisite

- ➢ **CSL101 or CSL102**
  - Also need to know basic image processing skills, but if not, assume that you can learn quickly
  - MatLab programming environment
  - Pattern Recognition $\rightarrow$ Few Lectures
  - Good programming skills
  - Translate algorithms $\rightarrow$ pseudo-codes $\rightarrow$ codes
  - Speedy review in the 1st week
- ➢ **EEL751**
  - Not essential
  - Recommended to be taken concurrently
- ➢ **Basic mathematical skills**
  - Solving recursive equations, manipulation of symbols, etc.

# Lecture Format

- ➤ Slides and transparencies
- ➤ Illustrative examples
  - Supplement the slides and transparencies
- ➤ Lectures
  - Come regularly
  - It is your responsibility to catch up your missed lectures with your friends
- ➤ Assignments
  - No Tutorials!
  - Group Project
  - Individual Presentations
  - Paper Critique
  - More rigorous problems to consolidate your knowledge
- ➤ Invited Lectures

# Grading Scheme (Tentative)

- Paper Critique
  - Review on two papers (10% each)
  - Presentation on the review
  - Done and handed in individually
  - Details will be announced later
- Group Project
  - 30%
  - Implementation of an algorithm for the selected biometric
  - Presentation on your implementation
  - Material included in the lecture, closed-note and closed-book
- Minor I and Minor II
  - 15% Each
  - Spring 2006, Details will be announced later
- Major
  - 20%

# Minors and Major

- ➤ Individually done

- ➤ Closed-book, closed-notes

- ➤ No early or late examination
  - Unless under very unusual circumstances, with letters of proof
  - Instructor informed beforehand

# Thou Shall Not Cheat

- ➤ Do not cheat
- ➤ I encourage you to discuss your assignments with your friends
  - Put everything in your own words
- ➤ But no copying
  - It is NOT a shame of not knowing how to do
  - Copying causes damage to your integrity and respect
  - Copying is stealing intellectual property
  - TAs will catch cheaters
- ➤ What if you are caught copying?
  - Both the copier and the originator get 0
  - 2nd time: Both get 0 *and* one full downgrade
  - Caught 3rd time: FAIL
  - If it is minor or major, an automatic FAIL

# Email Policy

- ➢ Email is not effective to explain things. Please visit TA's offices

- ➢ Please do not expect answers right away

- ➢ Please do not send us codes for debugging
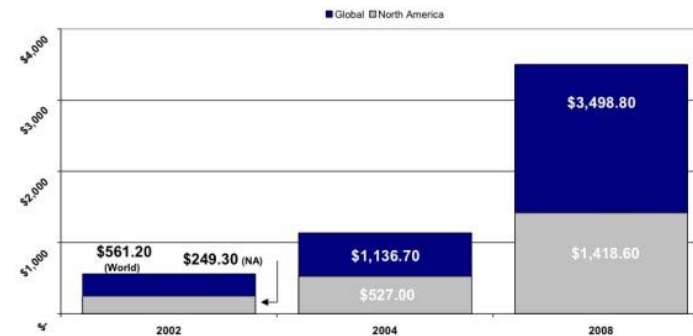
  - ▪ We would not debug codes for you

# Motivation

➢ The *double dipping* in social welfare schemes are estimated around $40 billion

➢ Majority of annual $450 million Mastercard credit card fraud is due to identity fraud

➢ Multifaceted areas of applications
- E-commerce, Passports, Secured Access

➢ Understanding is must to improve/change

Total Biometric Revenues 2002 - 2007 ($m)

| Year | Revenue |
|------|---------|
| 2002 | 601 |
| 2003 | 928 |
| 2004 | 1,467 |
| 2005 | 2,199 |
| 2006 | 3,112 |
| 2007 | 4,035 |

Copyright © 2002 International Biometric Group
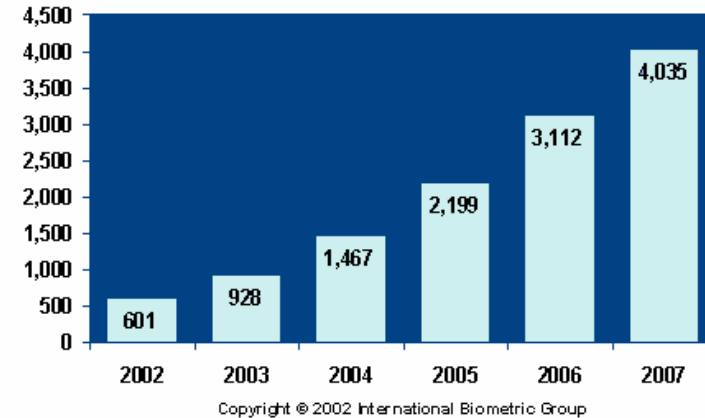
North American & Global Biometrics Market (2002, 2004 & 2008)

■ Global □ North America

| Year | Global | North America |
|------|--------|---------------|
| 2002 | $561.20 (World) | $249.30 (NA) |
| 2004 | $1,136.70 | $527.00 |
| 2008 | $3,498.80 | $1,418.60 |

# Motivation

## Biometrics Applications


Fingerprint at check-out counter
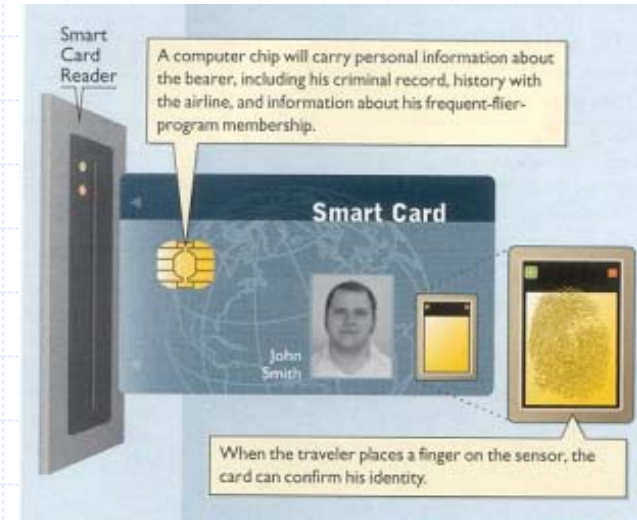

Face scan at airports

The St. Petersburg-Clearwater Airport installed facial recognition systems at two security checkpoints in January. Six-foot tall towers (above) house cameras that snap pictures of passengers as they pass through magneto-meters. The passengers' faces instantly are compared to a database of images of wanted criminals. Sheriff Everett Rice (above left) was one of the first people to pass through the new security system.


Hand Geometry for Immigration


Iris-based ATM


Smart card with fingerprints

# Motivation



2003 Comparative Market Share by Technology
(Does not include AFIS revenue)
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Signature-Scan 2.4%
Keystroke-Scan 0.3%
Voice-Scan 4.1%
Iris-Scan 7.3%
Middleware 12.4%
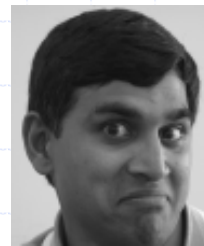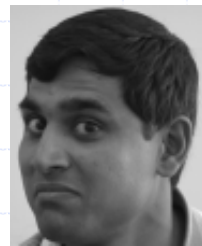Hand-Scan 10.0%
Facial-Scan 11.4%
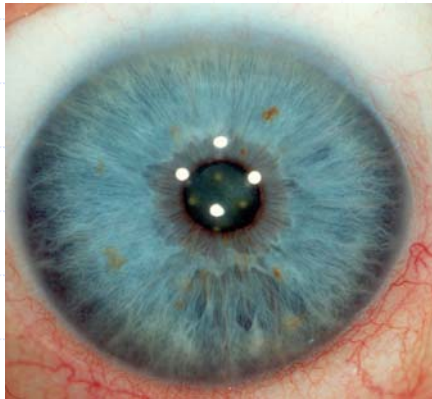Finger-Scan 52.0%
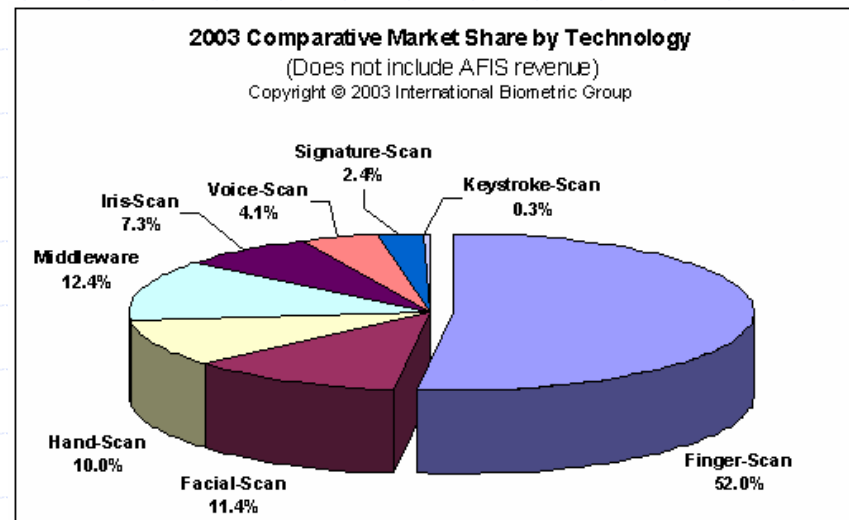
# Motivation

How can we recognize two different fingerprints?



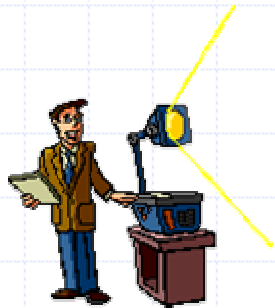How does the face recognition works?

# Motivation

How two Iris images are different?
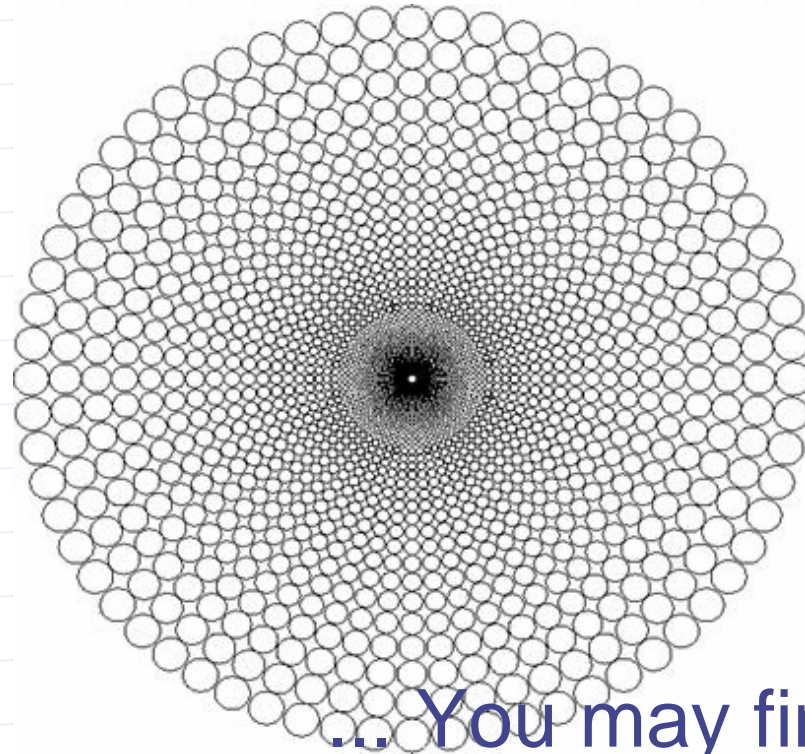


Which Biometric is the best?

# Motivation

How to automatically recognize two twins?



**If you study Biometrics, you can know!**

# Motivation

**We have some answers but  some more questions too...**



... You may find this out

When you study Biometrics...