

# Multiple Biometric Grand Challenge Kick-Off Workshop

18 April 2008

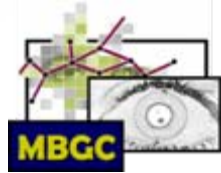
National Institute of  
Standards and Technology



NIST

*...working with industry to foster innovation, trade, security and jobs*

# MBGC Sponsors



## Executing Agency



## Sponsoring Agencies





# The MBGC Team

- NIST
  - P. Jonathon Phillips, Test Director
  - Elaine Newton
- Colorado State University
  - Ross Beveridge & Geoff Givens
- SAIC
  - Todd Scruggs
- Schafer Corporation
  - Cathy Schott
- University of Notre Dame
  - Kevin Bowyer & Patrick Flynn
- University of Texas at Dallas
  - Alice O'Toole



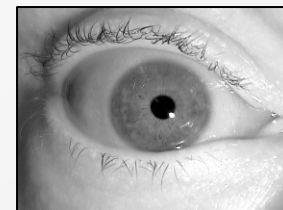
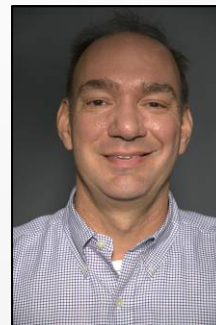


# Overview

- Background
- MBGC Overview
  - MBGC Goal
  - MBGC Structure
  - Challenge Problem Descriptions
  - How to get the MBGC Data

# Challenge Problems

- What are challenge problems?
  - A series of experiments designed to advance a technology's state-of-the-art
    - Experiments designed
    - Experiments and test data distributed to researchers
    - Researchers complete experiments and submit results
    - Scores are consolidated and reported
  - Introduction of new technology
    - Specific to MBGC





# Challenge Problem

- What is provided to participants
  - Data (biometric samples)
  - Ground truth (subject ids)
  - Experiment description
  - Score code
  - Standard results format
- What is requested from participants
  - Submission of results



# New Technology Development

- Very high resolution Near Infrared (NIR) portal sequences
- Iris video
- Fusion of multi-modal video
- Unconstrained face recognition
- Realistic mug shot and passport images



# What to Expect from the MBGC

- MBGC will determine performance improvement on face and iris recognition
- Results will measure:
  - Improvement obtained from video
  - If more samples of existing mode improve performance
  - Effect of resolution on still face
  - Improvement obtained through fusion of face and iris



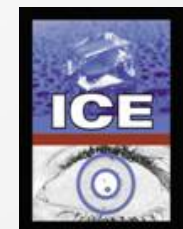
# Background



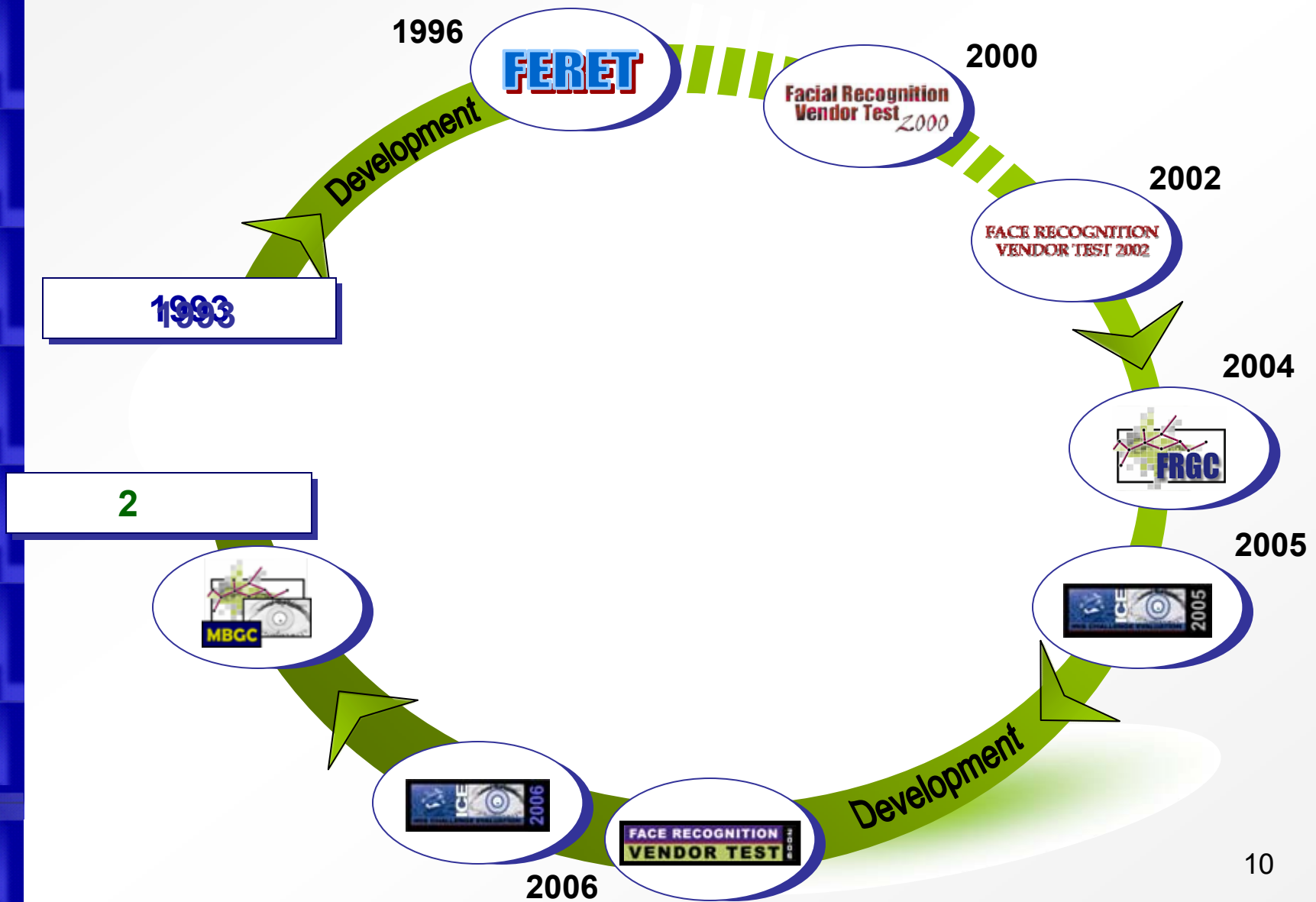
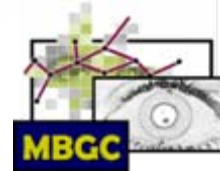
- FERET 1993-1997
  - Army Research Lab challenge problem/evaluation
- Face Recognition Vendor Test (FRVT) 2000
  - DARPA, NIST, DoD CTRP and NIJ Evaluation
- FRVT 2002
  - DARPA, NIST and DoD CTRP Evaluation
- HumanID Gait Challenge 2002-2003
  - DARPA Challenge problem
- Face Recognition Grand Challenge 2004-2006
  - NIST directed challenge problem
- FRVT 2006
  - NIST directed evaluation
- Iris Challenge Evaluation (ICE) 2005-2006
  - NIST directed challenge problem and evaluation
- Multiple Biometrics Grand Challenge (MBGC) 2008
  - NIST directed challenge problem

Facial Recognition  
Vendor Test *2000*

FR<sub>0</sub>  
VT<sub>2</sub>

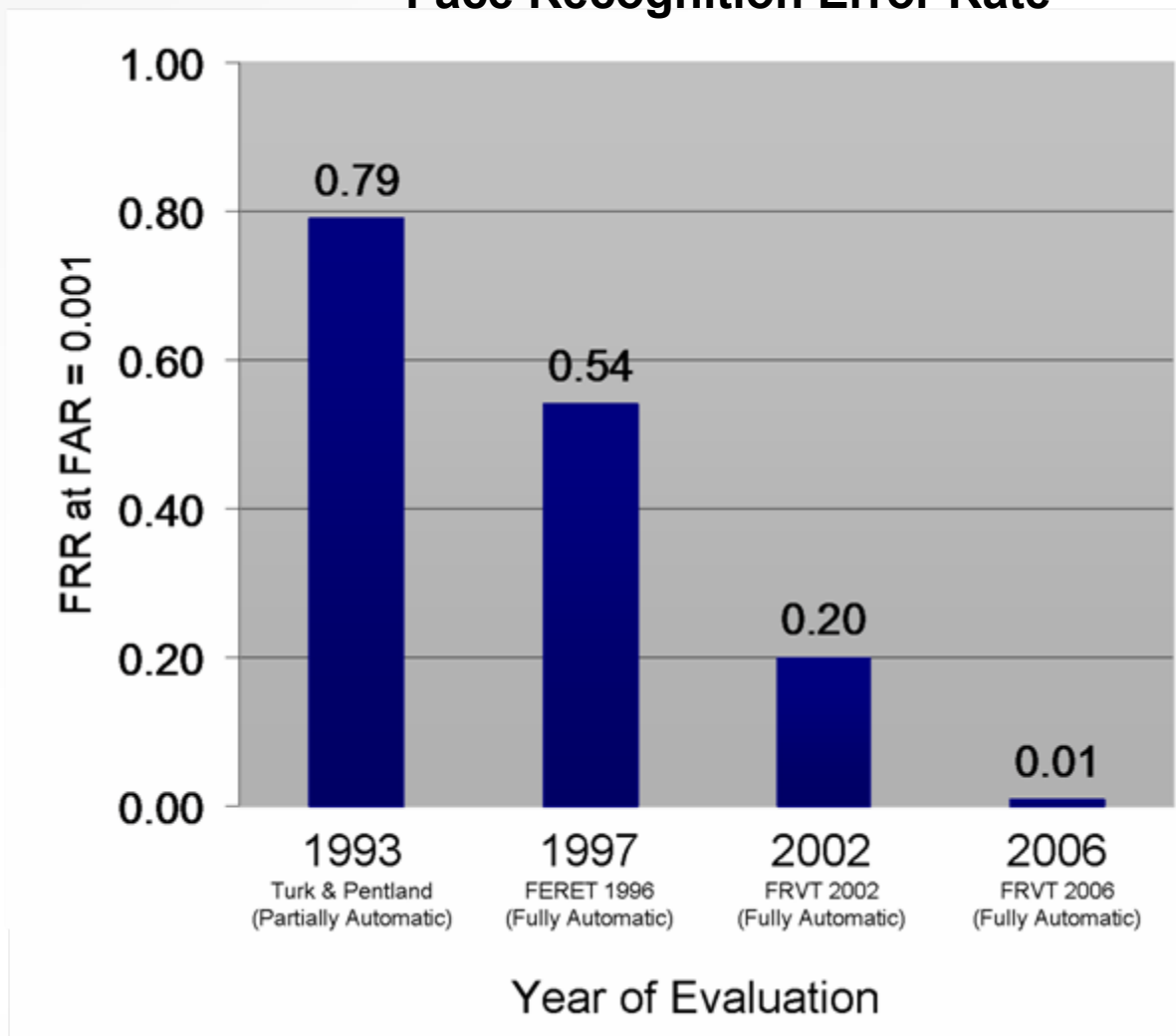


# Technology Progress



# Improved FR Performance

## Face Recognition Error Rate



Single Still  
Controlled  
Different Days

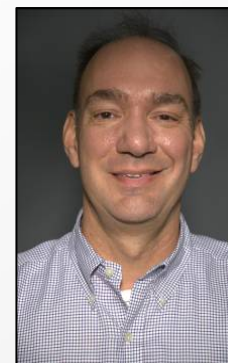
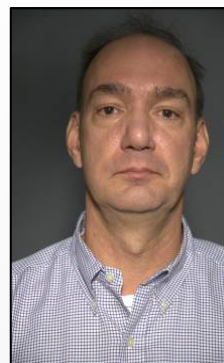
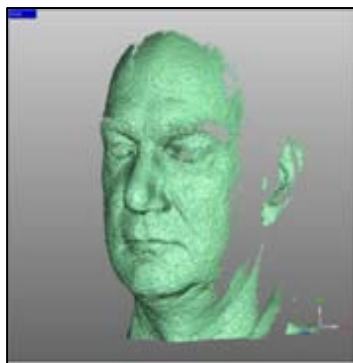


# Iris Recognition

- ICE 2005 and 2006
  - First challenge problem and independent technology evaluation on multiple algorithms
  - Provided performance baseline
  - Patent expiration allowed broader technology development

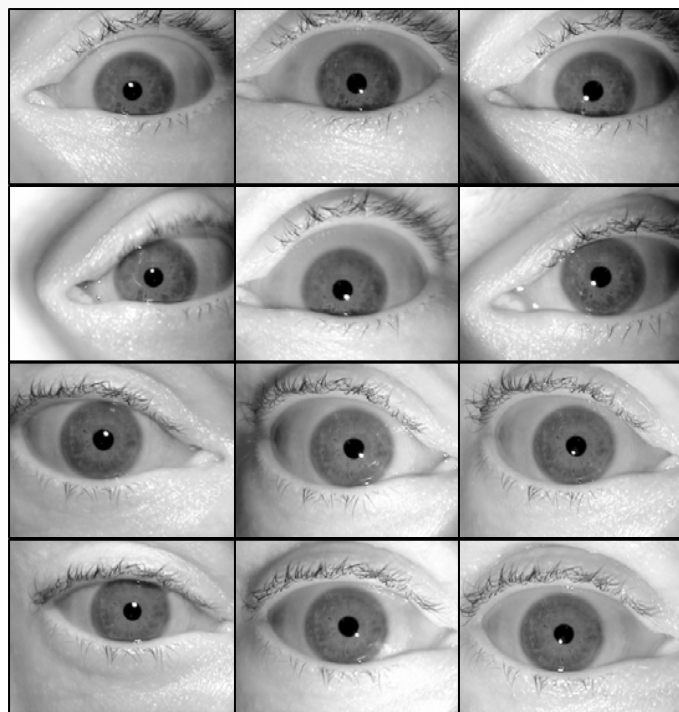
# What does progress mean?

- FERET, FRGC and FRVT 2006
  - Controlled images:

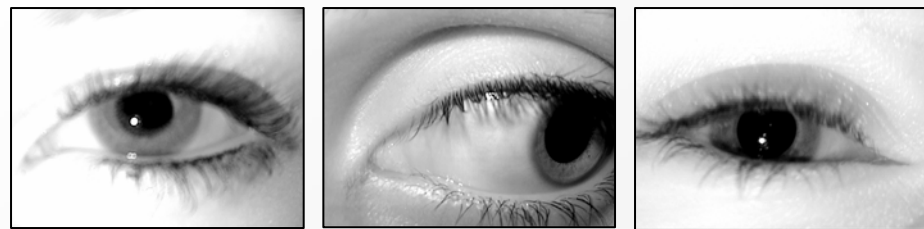
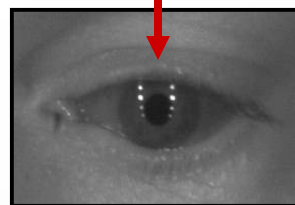


# What about iris recognition?

- ICE 2006 images

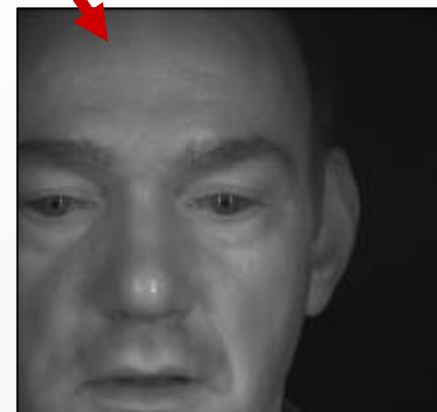


- MBGC type images

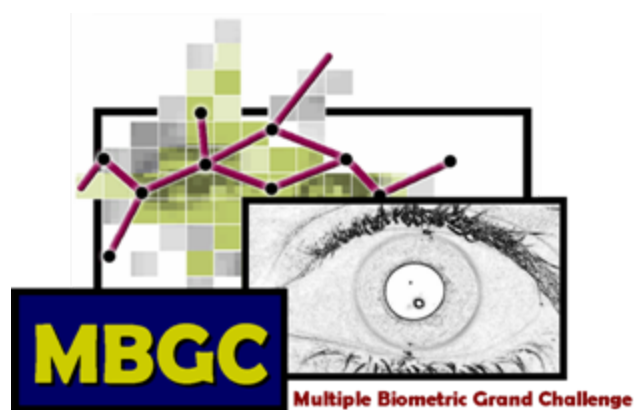


# What about these images?

- MBGC plans to address these types of images:



# Multiple Biometric Grand Challenge







# MBGC Goal

- The main goal of the Multiple Biometric Grand Challenge (MBGC) is to

– Address face and iris recognition problems that are more relevant to those found in operational data

- Low to medium resolution face
- Still and video iris
- Near Infrared (NIR) & High Definition (HD) video from portals
- Unconstrained face recognition from still & video



# MBGC Goal

- Programmatic Method

- **Sequence of challenge problems**

- **Modeled after the FRGC and ICE 2005**
- **Challenge problems and data distributed to researchers**

- **Workshops**

- **Planned independent technology evaluation**

# Timeline

- Estimated Task Schedule for MBGC:

Estimated Schedule	Task
December 2007	Formal announcement of MBGC project Begin data collection at University of Notre Dame Design protocols, challenge problems and prepare test infrastructure
April/May 2008	1st MBGC Workshop Release 1st challenge problem
October 2008	2nd MBGC Workshop Self-reported results on Challenge Problem 1 presented Release 2nd Challenge Problem
Spring 2009	3rd MBGC Workshop Self-reported results on Challenge Problem 2 presented
Spring/Summer 2009	Planned Multi-Biometric Evaluation (MBE) 2009 (Option)

# MBGC Challenge Problems

Worked with sponsors over a 12-month period to define problems

## Portal Video



## Video Face



## Still Face



Mugshot



ICAO-ISO  
Standard

# Portal Challenge Problem

## Portal Video



Mugshot

ICAO-ISO  
Standard



# Motivations

- Rapid acquisition of biometrics at points of entry
- Non-invasive capture

# Portal Goals

- Algorithm development
  - Biometrics: face and iris
  - Modes: iris video, NIR video, HD video



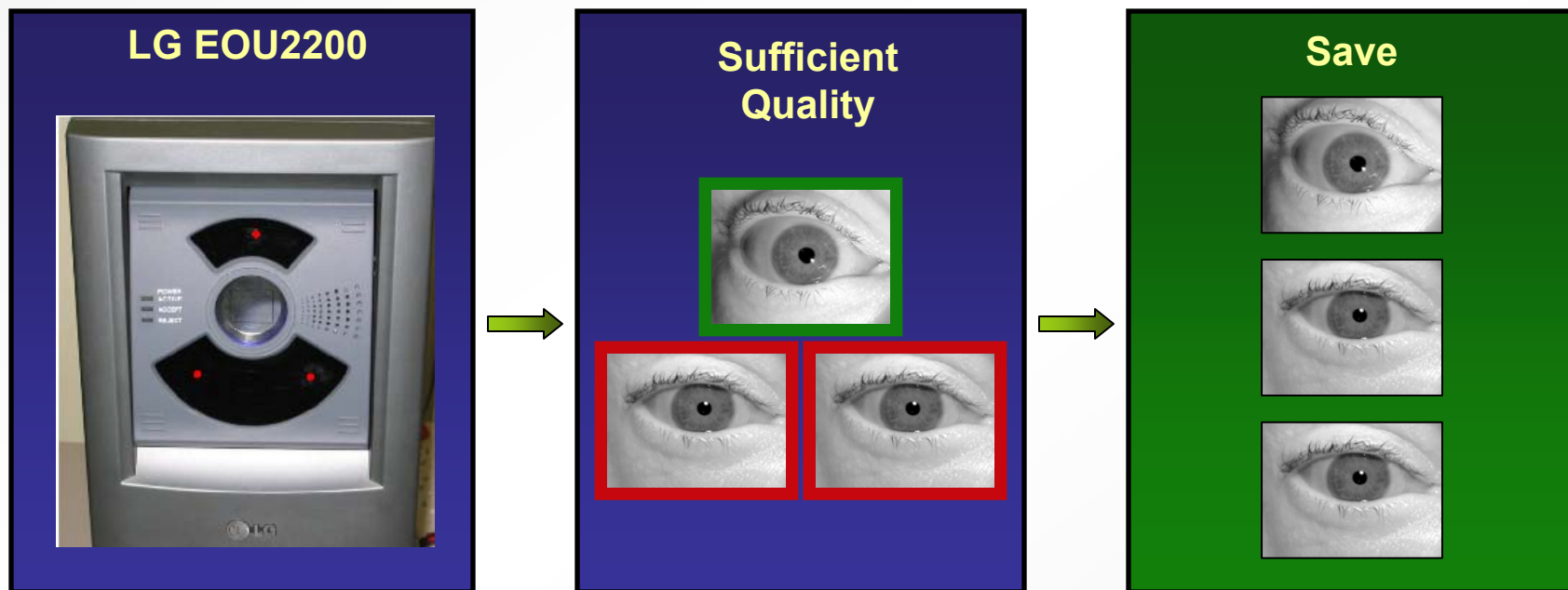


# Meet the Sensors....



# Meet the LG 2200

## MBGC Iris Acquisition System

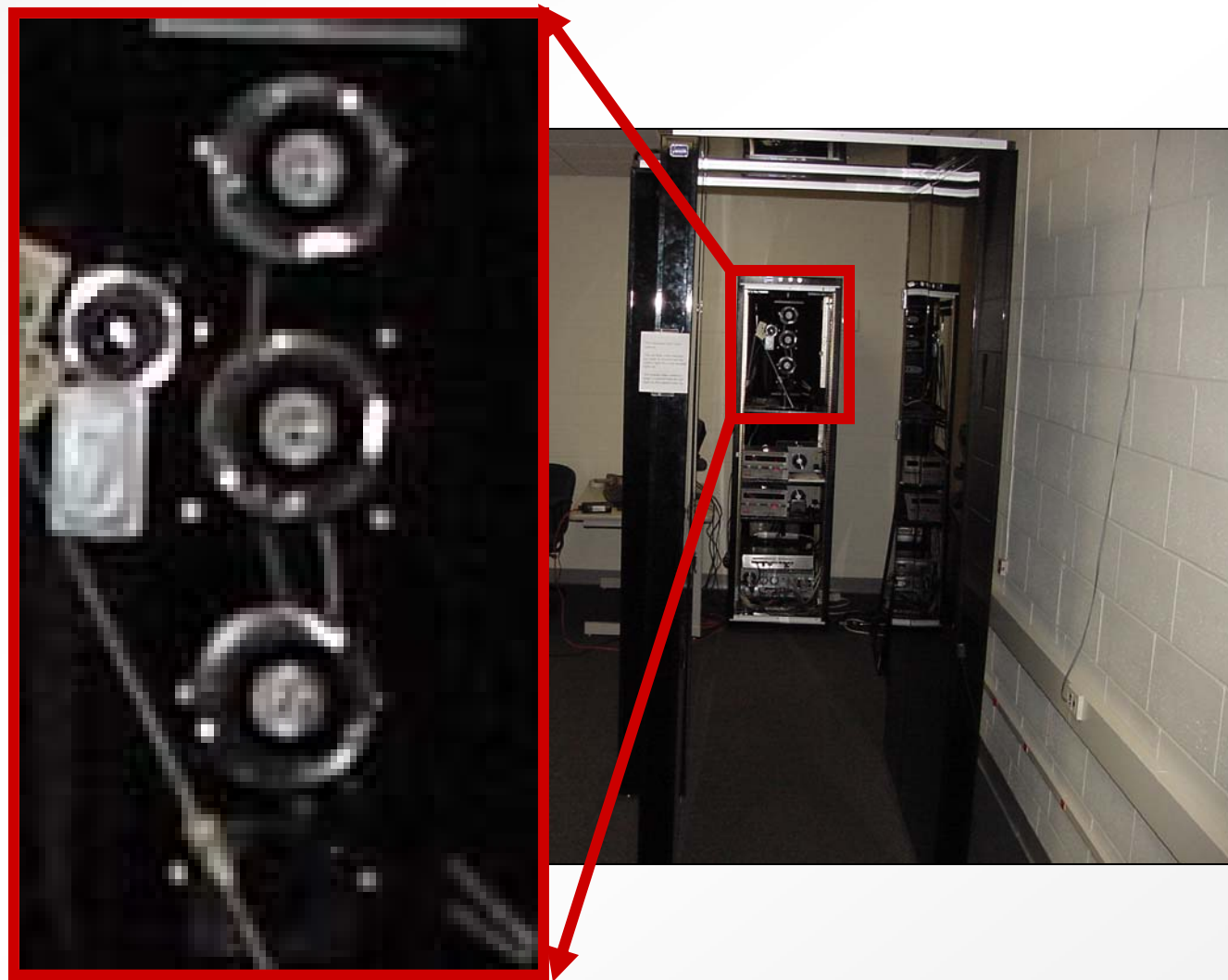


- Take 3 iris images
- One above quality threshold
- Save all three

# Meet the Portal

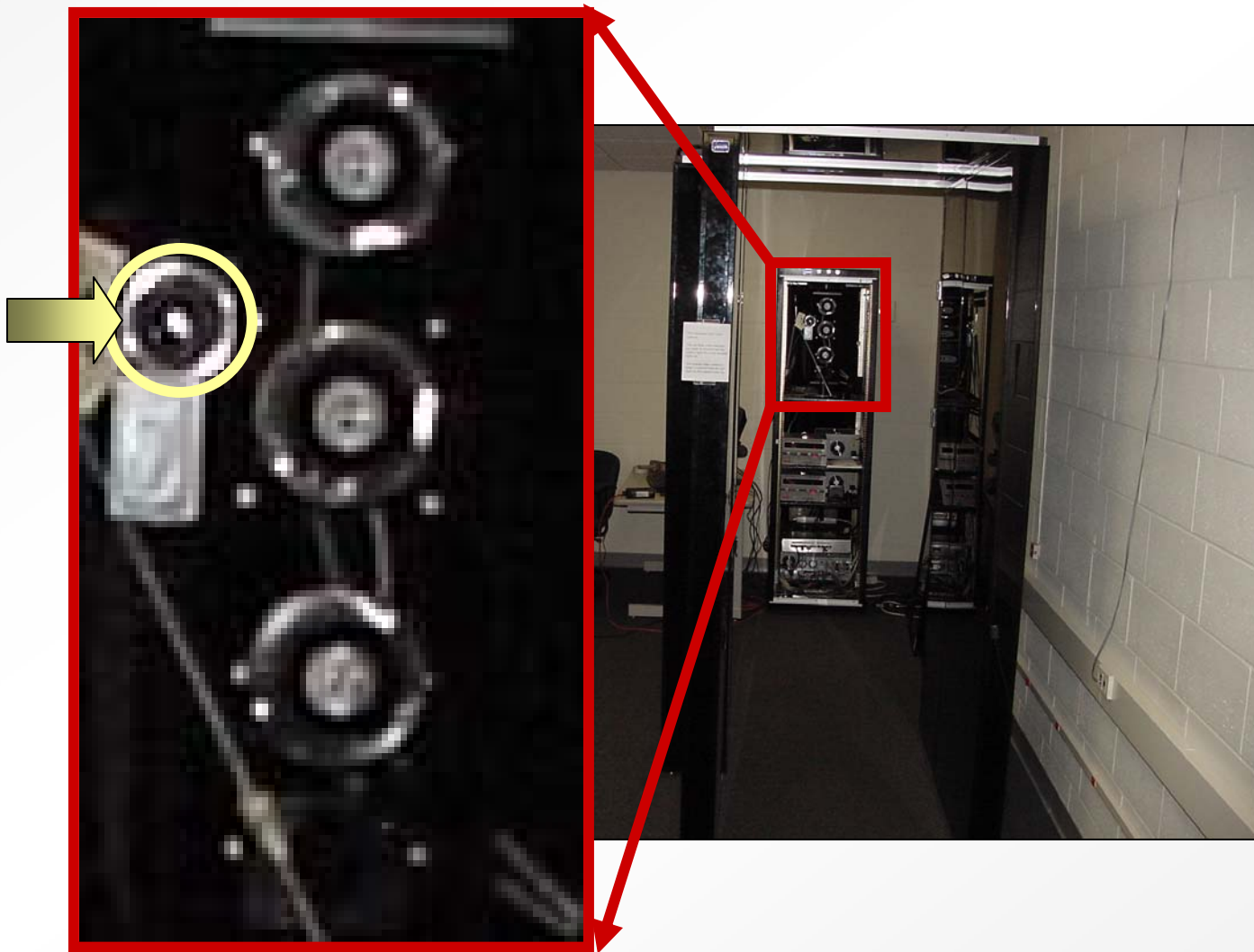


# Meet the Portal



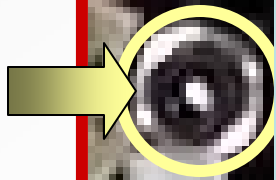
# Meet the Portal

High  
Definition  
(HD) Video  
Camera

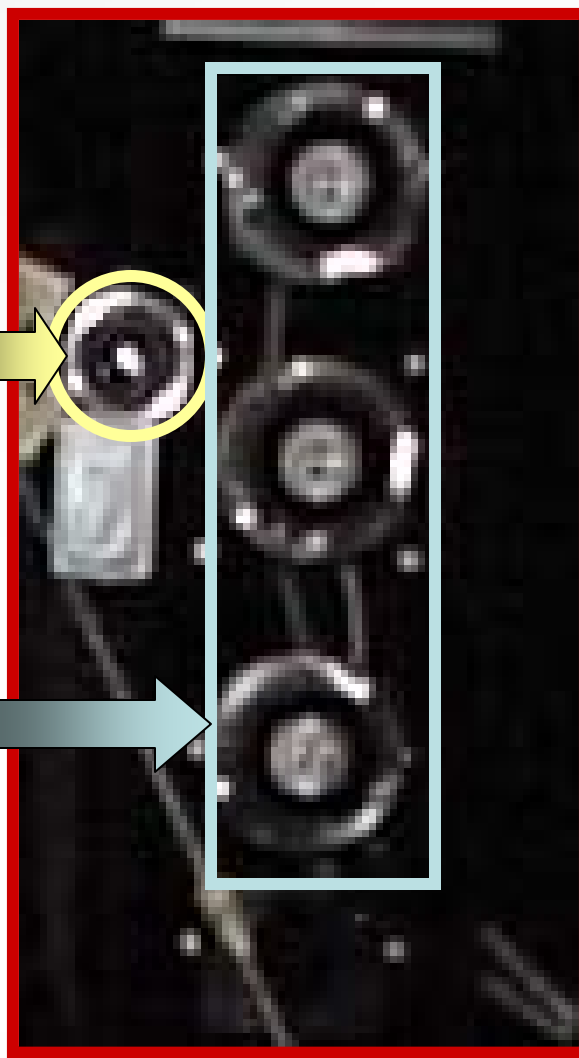


# Meet the Portal

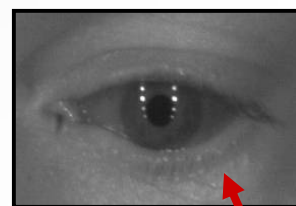
High  
Definition  
(HD) Video  
Camera



Near Infrared  
(NIR) Video  
Cameras



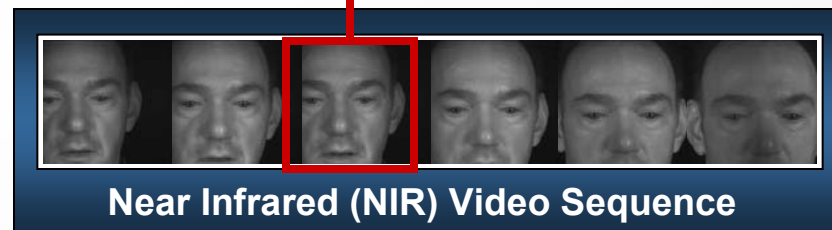
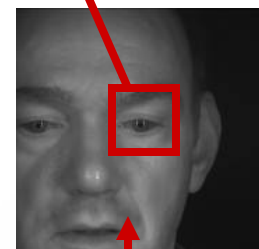
# Meet the Portal



120 pixels  
across iris

2k

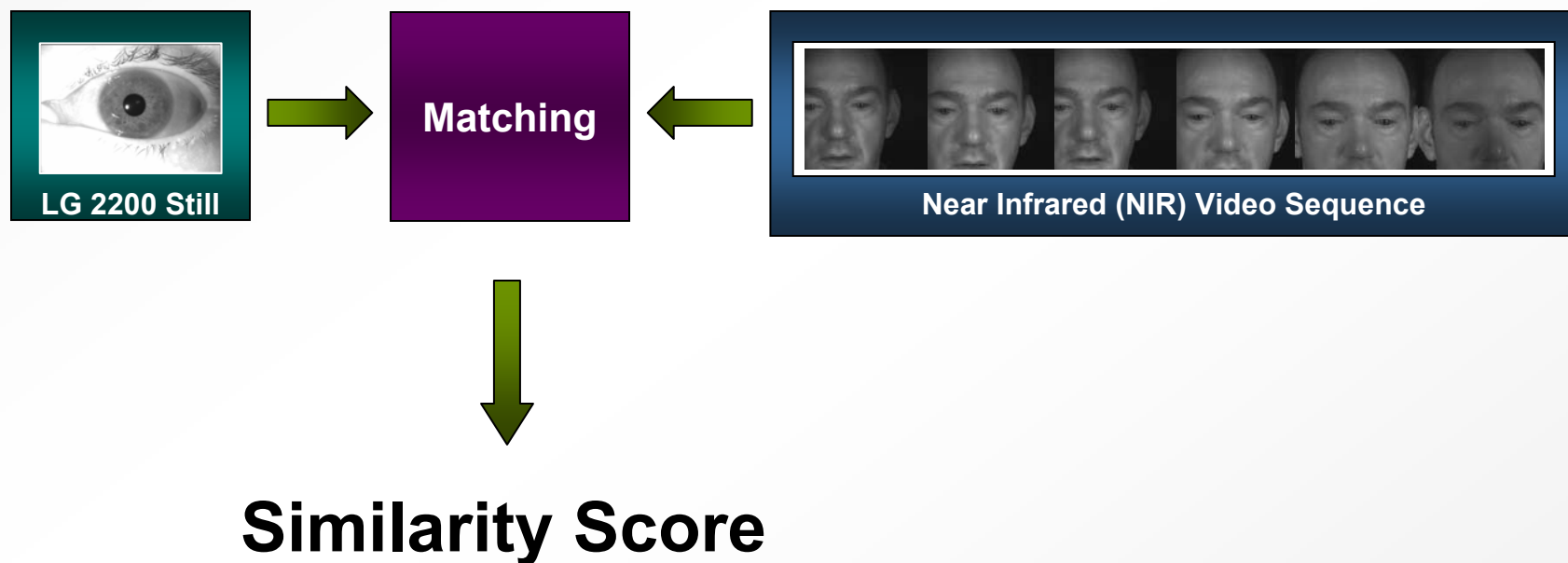
2k



# Experiment Terminology

- Target
  - Enrolled image
- Query
  - Image to be recognized

# Experiment: Still Iris versus NIR

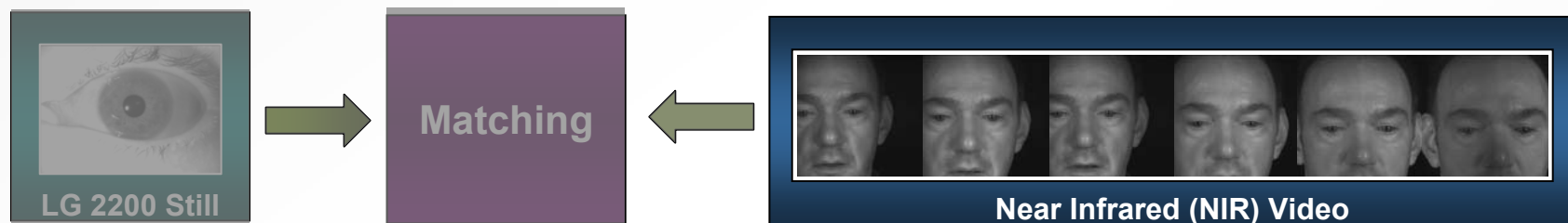




# Experiment: Still Iris versus NIR

Ground truth provided: Subject ID

Note: Input will be full video sequence



Similarity Score

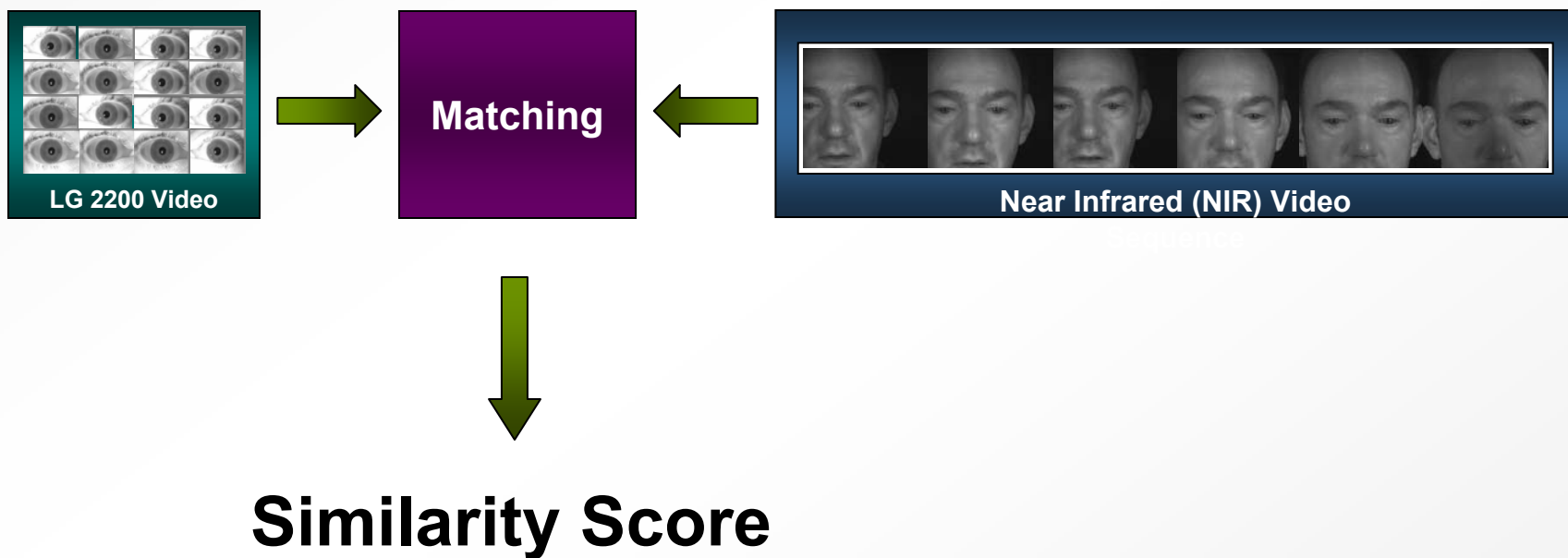
- Algorithm will need to:
  - Process Video
  - Locate Irises
  - Segment Irises
  - Generate Template or other Representation

# Meet the LG 2200 again....



## Iris Video Sequence

# Experiment: Video Iris versus NIR



# Experiment:

## Video Iris versus NIR

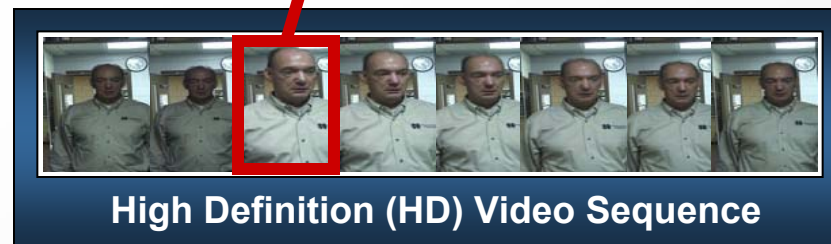
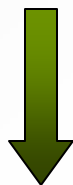
Both inputs will be full video sequences



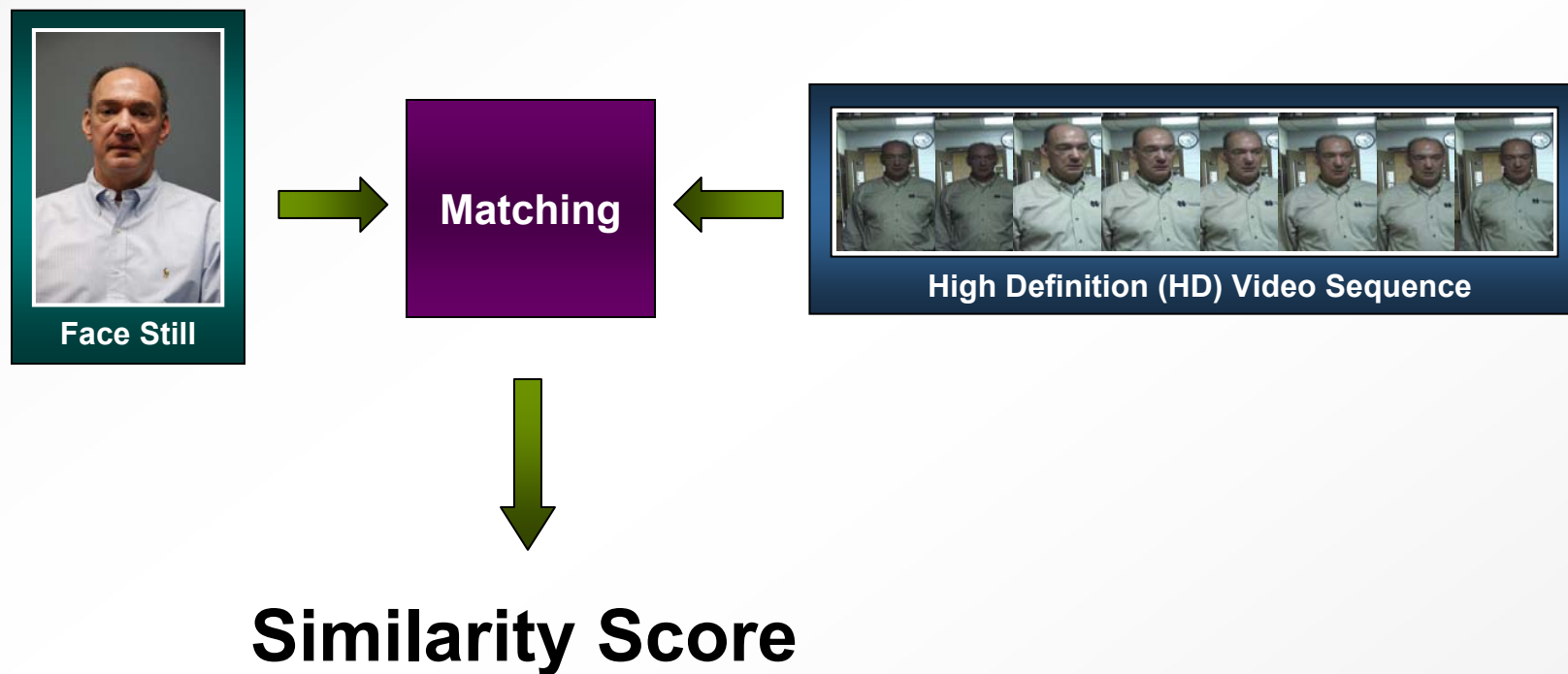
• Algorithms will need to:

- Process Video
- Locate Irises
- Segment Irises
- Generate Templates or other Representation

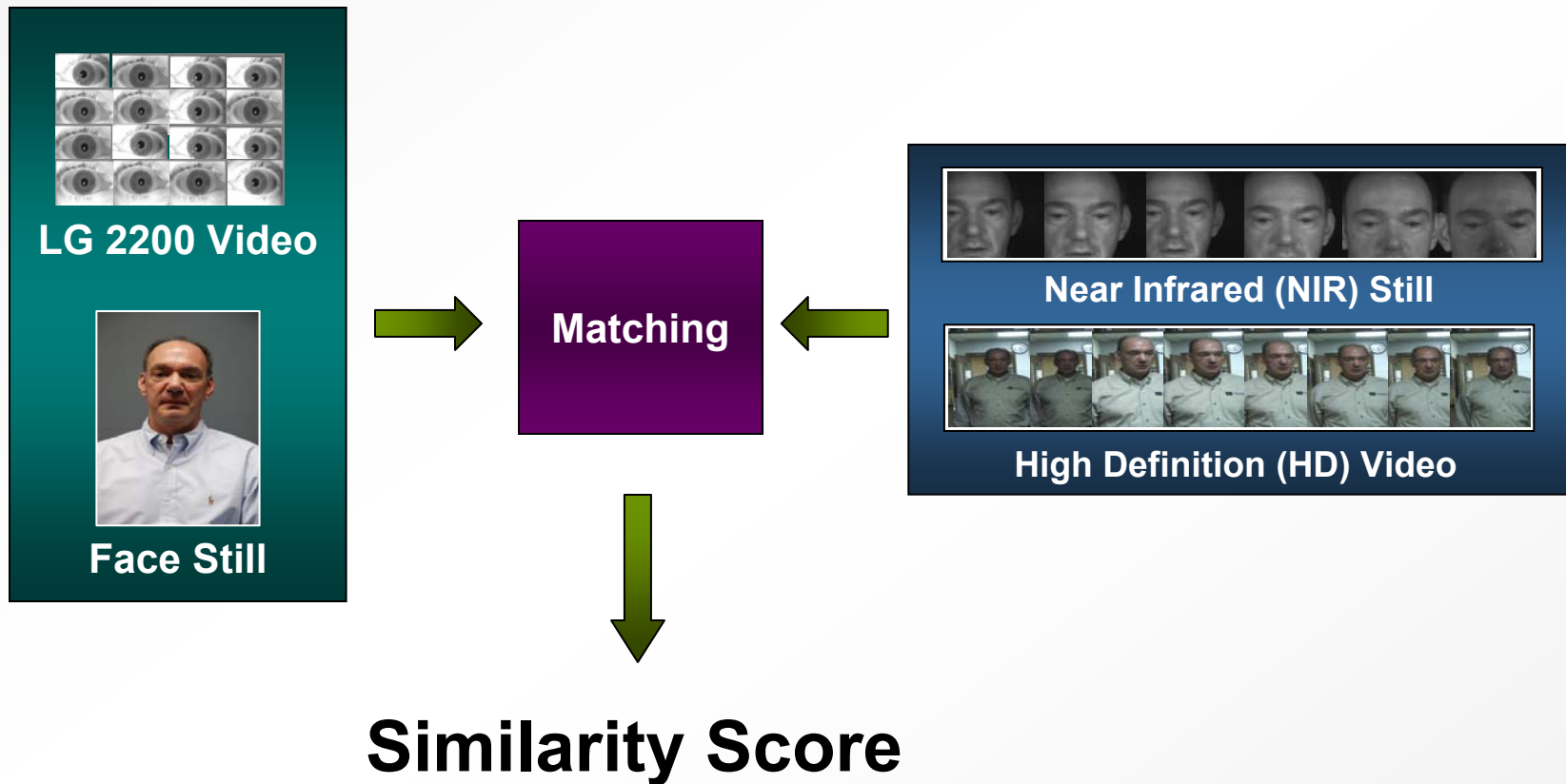
# Meet the Portal again....



# Experiment: Still Face versus HD Video Face

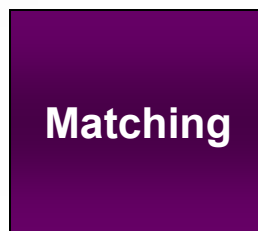


# Experiment: Multiple Biometrics

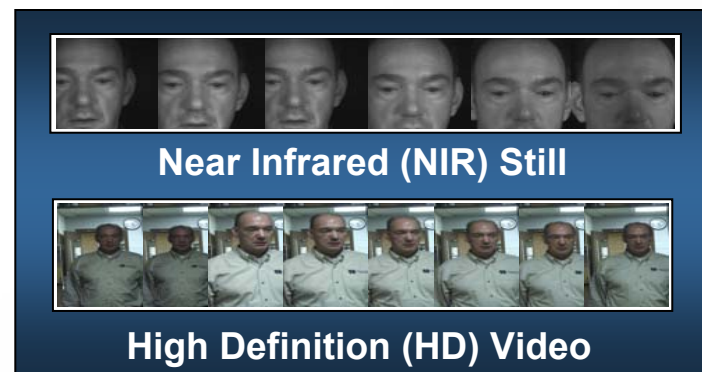


# Experiment: Multiple Biometrics

Input is iris video  
sequence and face still



Input is both video sequences



- Algorithms will need to:
  - Process all video sequences
  - Generate templates or other representation
  - Decide fusion strategy



# Quick Summary

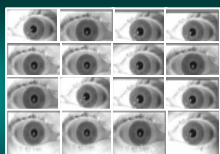


LG 2200 Still

Still Iris versus NIR



Near Infrared (NIR) Video Sequence



LG 2200 Video

Video Iris versus NIR



Near Infrared (NIR) Video Sequence



Face Still

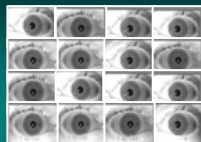
Still Face versus  
HD Video Face



High Definition (HD) Video Sequence

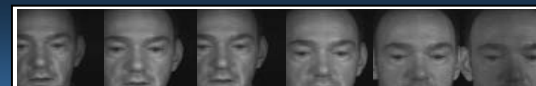


Face Still



LG 2200  
Video

Multiple Biometrics



Near Infrared (NIR) Still

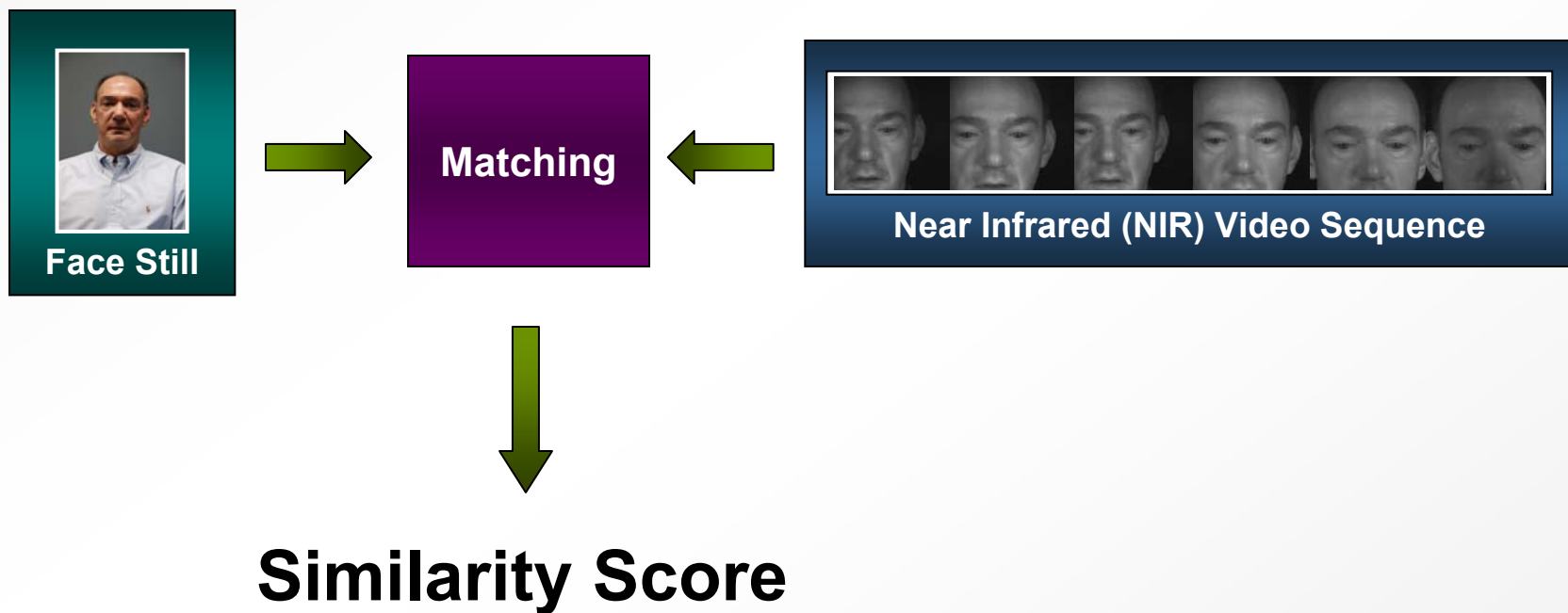
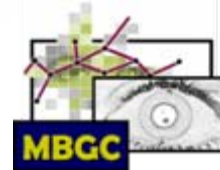


High Definition (HD) Video

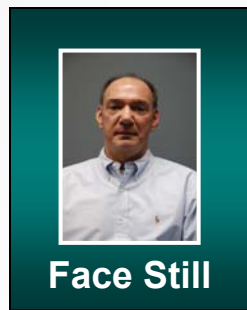


**Considerations you may not have thought of.....**

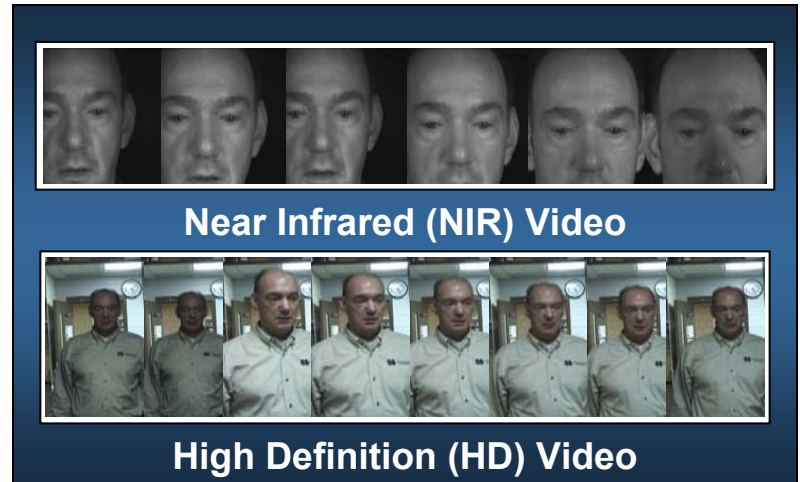
# Experiment: Cross-Mode Face



# Experiment: Multi-Mode Face

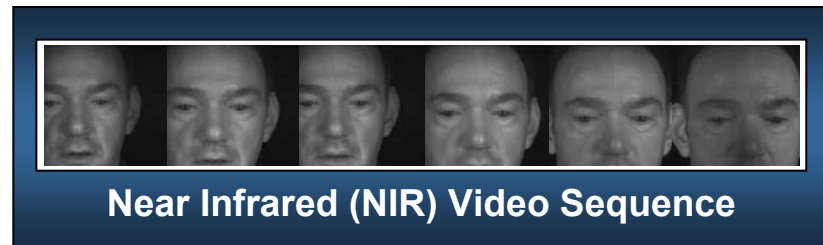
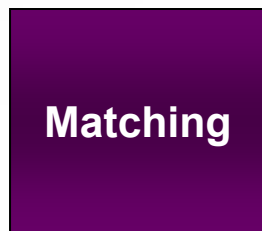


**Matching**



**Similarity Score**

# Experiment: Multi-Mode Face



**Similarity Score**

# Portal Summary

- Introduce new technology
- Seven experiments
- Multiple biometrics
- Assess impact of fusion



# Still Face Challenge Problem

## Still Face



Mugshot

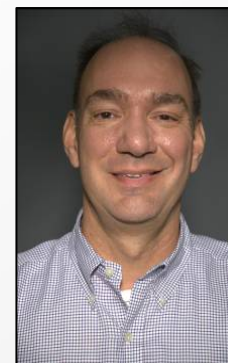
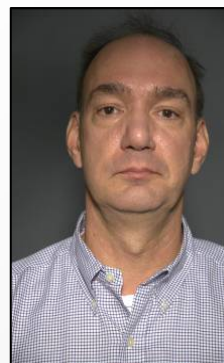
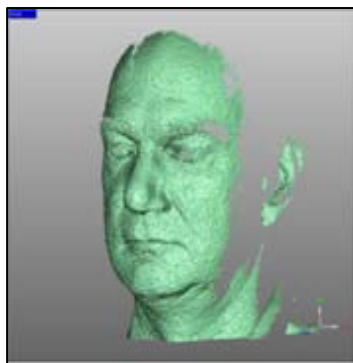


ICAO-ISO Standard

Standard

# Frontal Face

- FERET, FRGC and FRVT 2006
  - Controlled images:





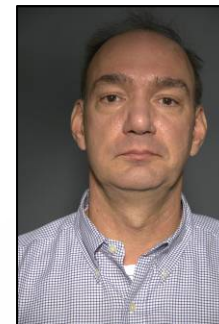
# Frontal Still Face

- Unconstrained Illumination:
  - High resolution camera
    - 4 and 6 megapixels
- Images for mug shots, passports and credential cards
  - Face size 90-120 pixels between the eyes compressed to 8k and 20k
    - ISO/IEC Standard



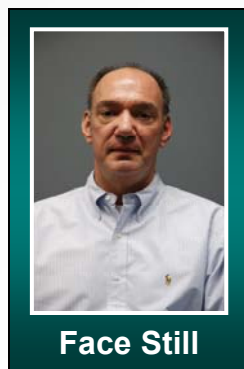
# Still Face

- Two target sets – AY03-04 (FRGC)
  - Controlled Illumination Frontal
    - 16,028 images
  - Uncontrolled Illumination Frontal
    - 8,014 images
- One query set – AY04-05
  - Uncontrolled Illumination Frontal
    - 13,785 images
      - Outdoors
      - Hallways and Atriums

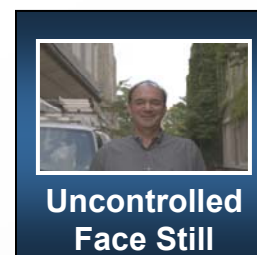


# Experiment: Still Face versus Still Face

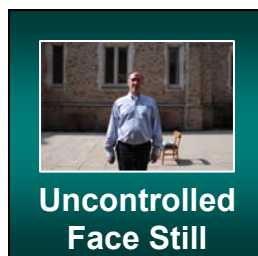
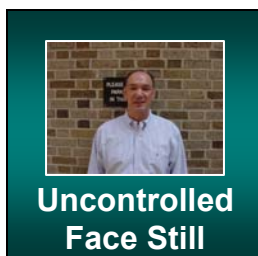
## Target Set



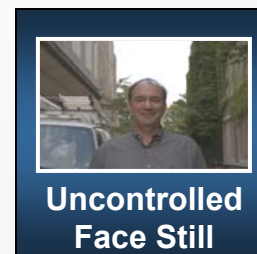
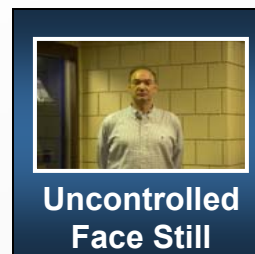
## Query Set



## Target Set



## Query Set

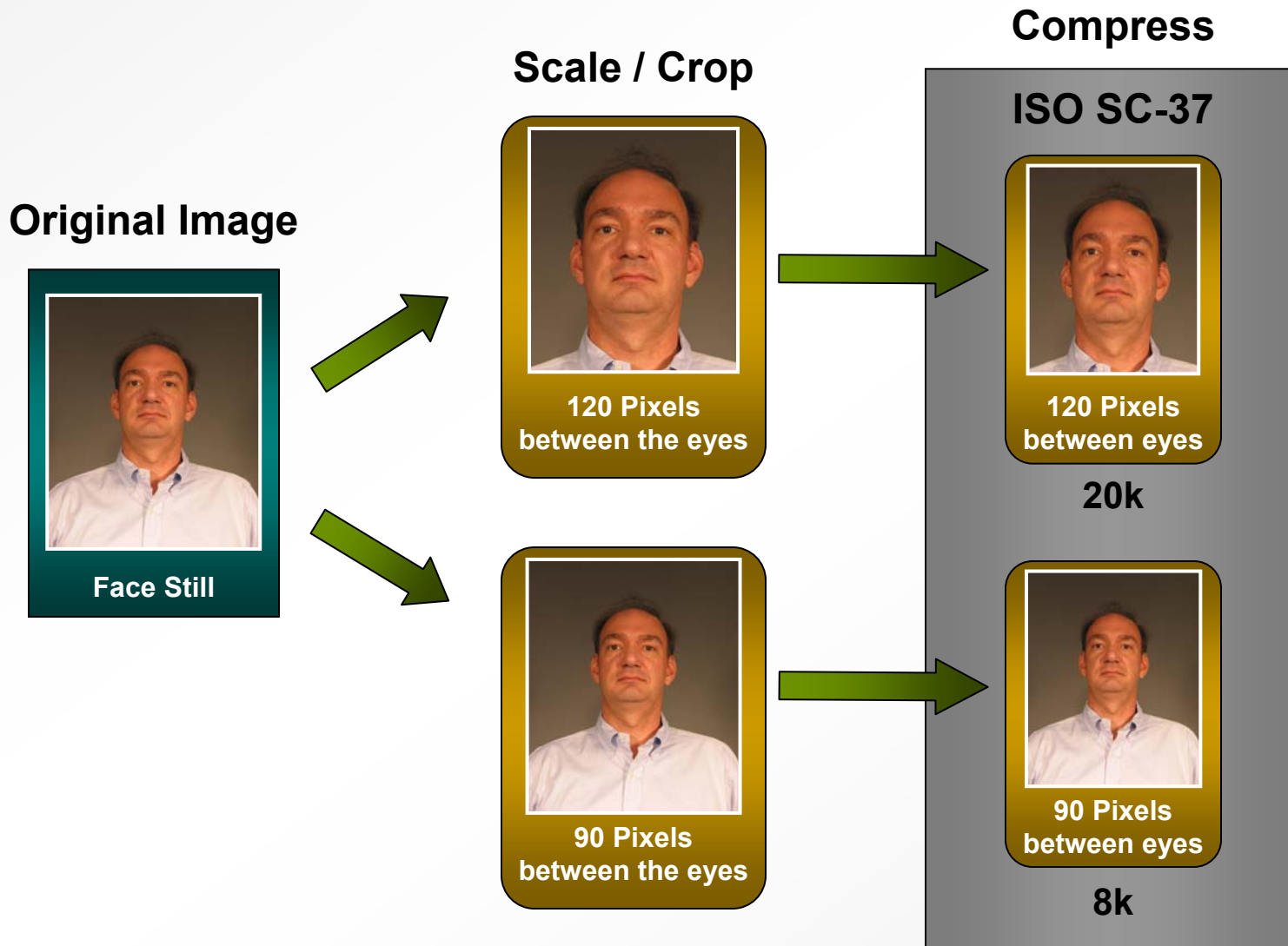




# Effects of Lower Resolution and Compression on FR

- Determine effect of
  - Lower resolution
  - Compression
- Process original images to meet data requirements
  - Scale and crop
    - 120 and 90 pixels between the eyes
  - Compress images
    - 20k and 8k

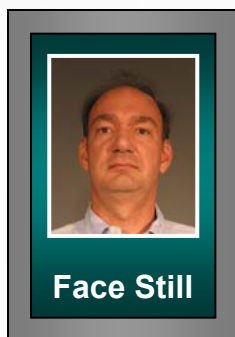
# Still Face Processing



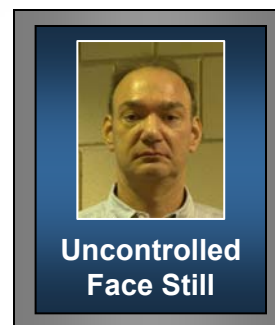
# Experiment: Still Face Compression 1

Compressed: 120 pixels between eyes, 20k

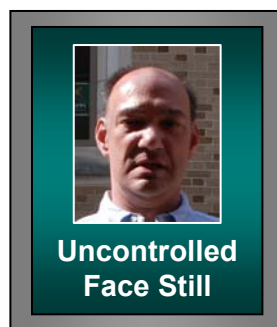
Target Set



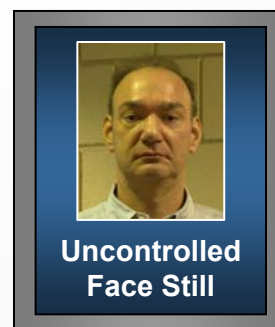
Query Set



Target Set



Query Set



 Target
  Query
  Compressed

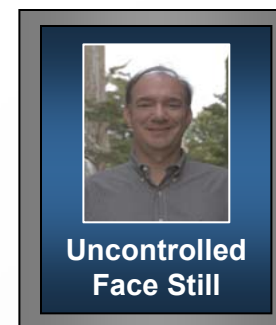
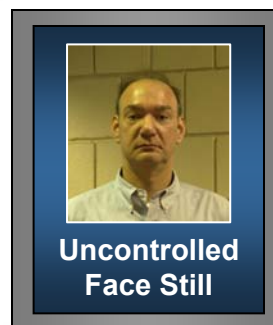
# Experiment: Still Face Compression 2

Compressed: 90 pixels between eyes, 8k

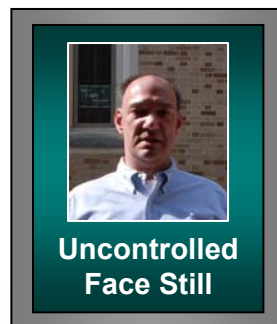
Target Set



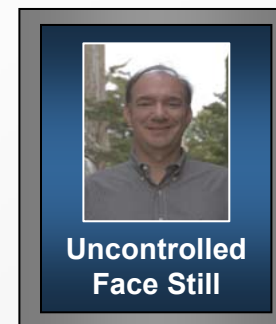
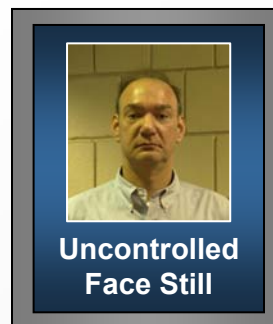
Query Set



Target Set



Query Set



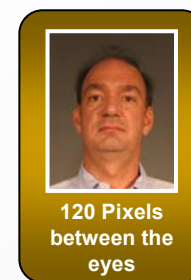
 Target  Query  Compressed

# Still Face Summary

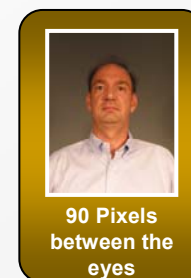
- Varying illumination
- Measure effects of compression and resolution
- Three experiments
  - High resolution
  - Two scaled and compressed



Original



20k



8k



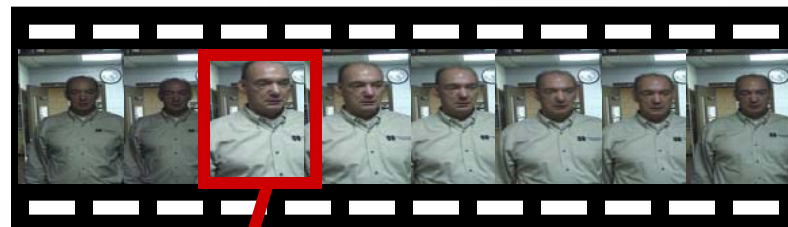
# Video Face Challenge Problem

## Video Face

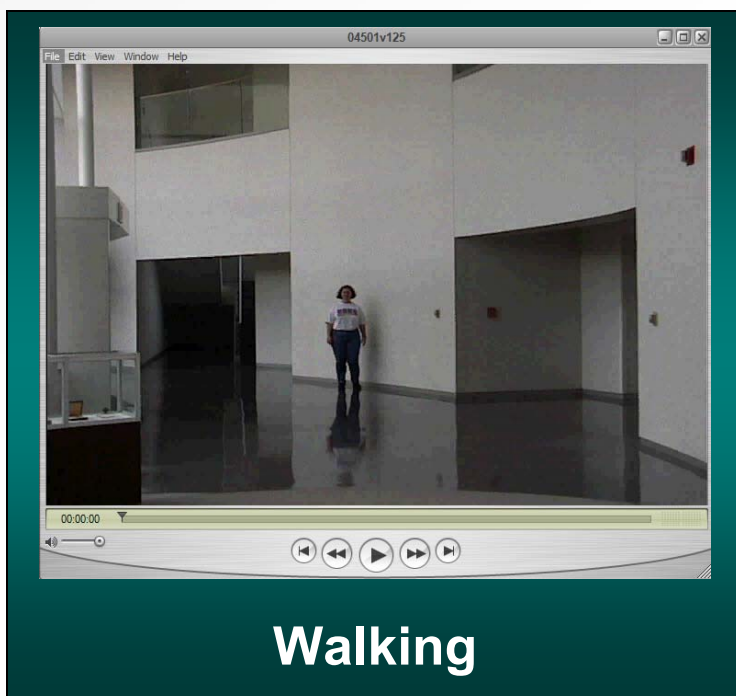


# Goal and Motivation

- Unconstrained face recognition
  - Still versus video
  - Video versus video



# Experiment: Video versus Video



# Experiment: Still versus Video



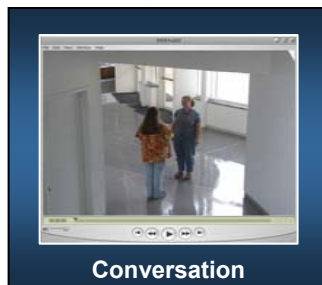
**Uncontrolled Face Still**



**Face Video**

# Video Summary

- Video to video
- Addressing unconstrained face recognition





# Quality

# Motivations

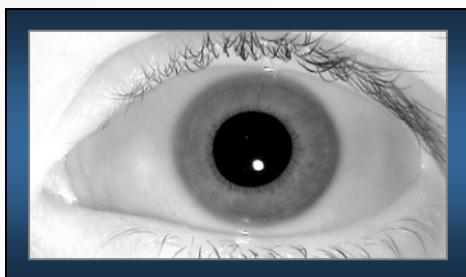
- Ensure control over enrollment processes
  - Do you get images that give you good matches?
- Confidence level in matching for degraded images
  - Reliability in producing a good match
  - What constitutes a good quality measure?

# Compute Image Quality

## Still Images



**Input Iris Image**

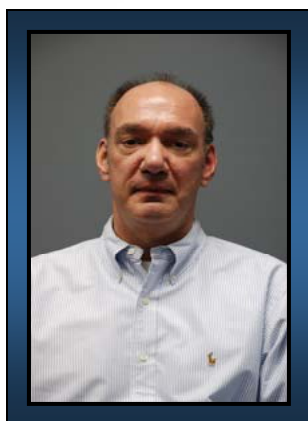


**Performer's  
Image Quality  
Module**



**Quality  
Measure**

**Input Face Image**



**Performer's  
Image Quality  
Module**



**Quality  
Measure**



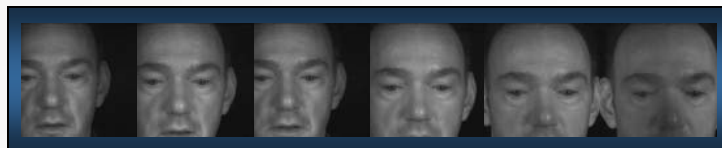


# Image Quality

- Optional submission
- Quality score per biometric sample

# Compute Image Quality Video

Input NIR

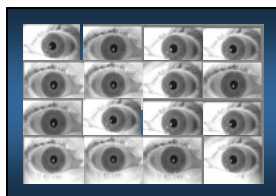


Performer's  
Image Quality  
Module



Quality  
Measure

Input Iris video

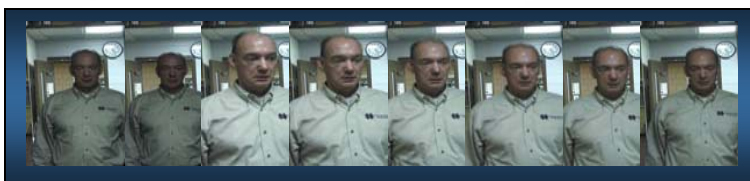


Performer's  
Image Quality  
Module



Quality  
Measure

Input HD Video



Performer's  
Image Quality  
Module



Quality  
Measure

# Compute Image Quality

## Multi-Modal

Input



Quality  
Measure

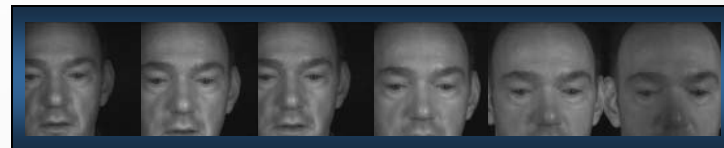
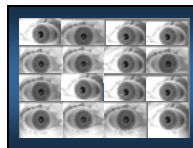
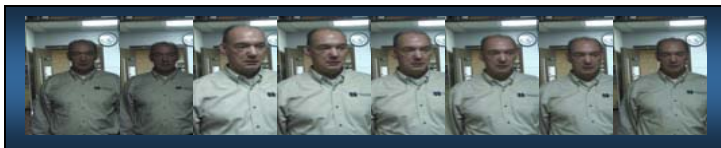
Input



Quality  
Measure

# Quality Summary

- Optional part of MBGC
- Assessment of quality measures
- Impact on fusion





# MBGC Mechanics



# Timeline

- Estimated Task Schedule for MBGC:

Estimated Schedule	Task
December 2007	Formal announcement of MBGC project Begin data collection at University of Notre Dame Design protocols, challenge problems and prepare test infrastructure
April/May 2008	1st MBGC Workshop Release 1st challenge problem
October 2008	2nd MBGC Workshop Self-reported results on Challenge Problem 1 presented Release 2nd Challenge Problem
Spring 2009	3rd MBGC Workshop Self-reported results on Challenge Problem 2 presented
Spring/Summer 2009	Planned Multi-Biometric Evaluation (MBE) 2009 (Option)



# What is provided by us....

- Challenge problem data
- Subject IDs
- XML sigset description
- Common results format
- Classes to read/write formats
- Scoring code
- Bash script for running experiments
  - Same arguments as FRVT 2006 & ICE 2006



# General Rules for Submitting

- Submit
  - Matching results (Similarity matrix)
  - Quality scores [optional]
- Can submit subset of experiments
- NIST reserves right to attribute performance



# Challenge Problems and Data Distribution



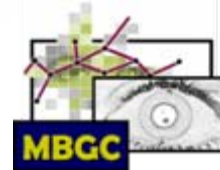
- Challenge problems and the first MBGC data set will be released sequentially starting **1 May 2008**
- To obtain data, you will need to submit data licenses signed by proper legal authorities
- Instructions for requests will be posted on MBGC website at <http://face.nist.gov/mbgc>



# Estimated Size of Challenge Problems

- Portal
  - 600 video sequences
  - 1400 stills
  - 100 Gigabytes
- Still face
  - 150,000 stills
  - 75 Gigabytes
- Video face
  - 1500 video sequences
  - 1500 stills
  - 150 Gigabytes

# Challenge Problems and Data Distribution



- What is the method of distribution?
  - Downloadable via rsync
  - Instructions for downloading data will be distributed after
    - Data licenses have been properly signed and submitted and your request has been processed

# Summary

- Multiple Biometric Grand Challenge (MBGC)
- Three challenge problems
- Multiple biometrics for portals
- Towards unconstrained face recognition

Portal Video



Still Face



Mugshot



ICAO-ISO  
Standard

Video Face

