

EVOLUTION OF THE HBSI MODEL

IPBC 2012 CONFERENCE PRESENTATION

14:25-14:50

RESPONSIVE RELEVANT RESULTS

CONTRIBUTORS TO THE PRESENTATION

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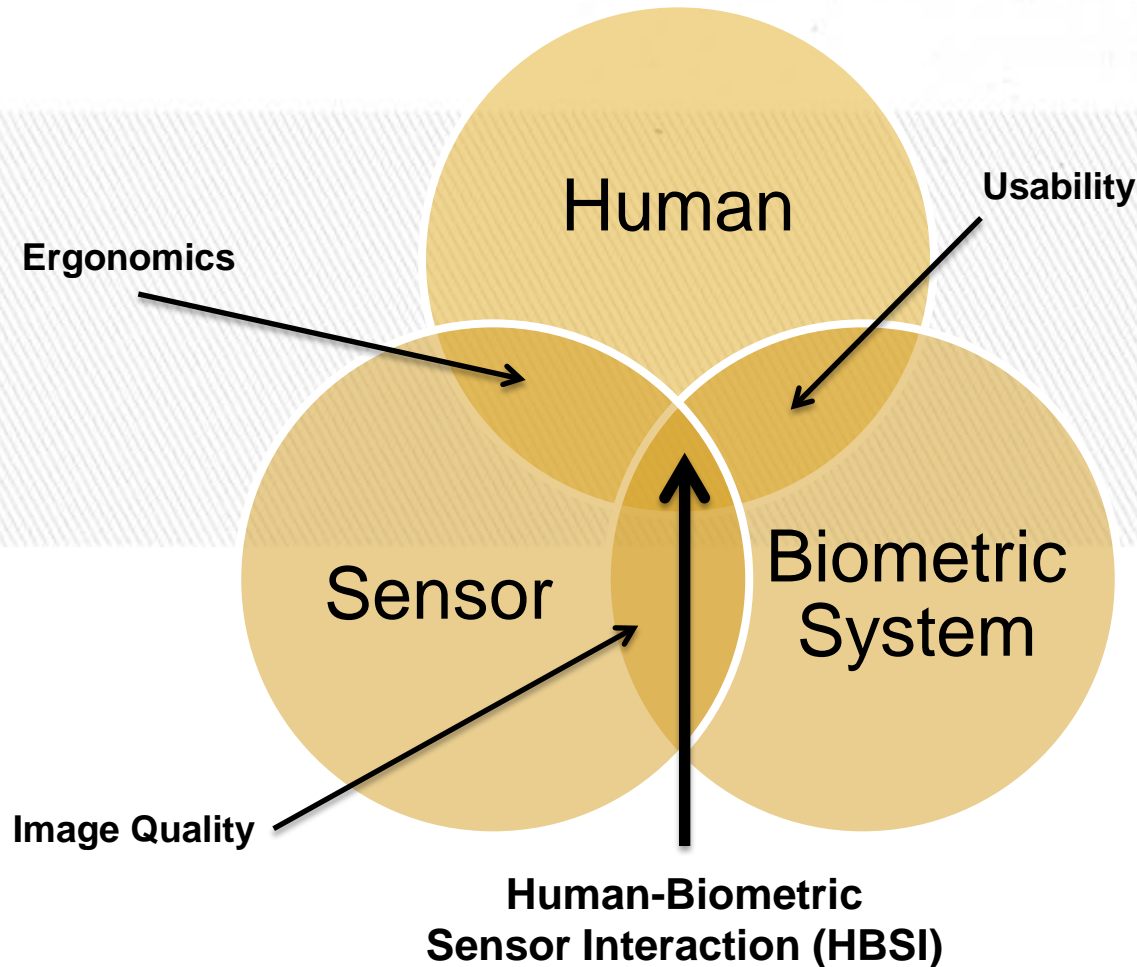
PRESENTATION

- Evolution of the model
- HBSI v3.0
- Future roadmap

DEVELOPMENT OF THE MODEL

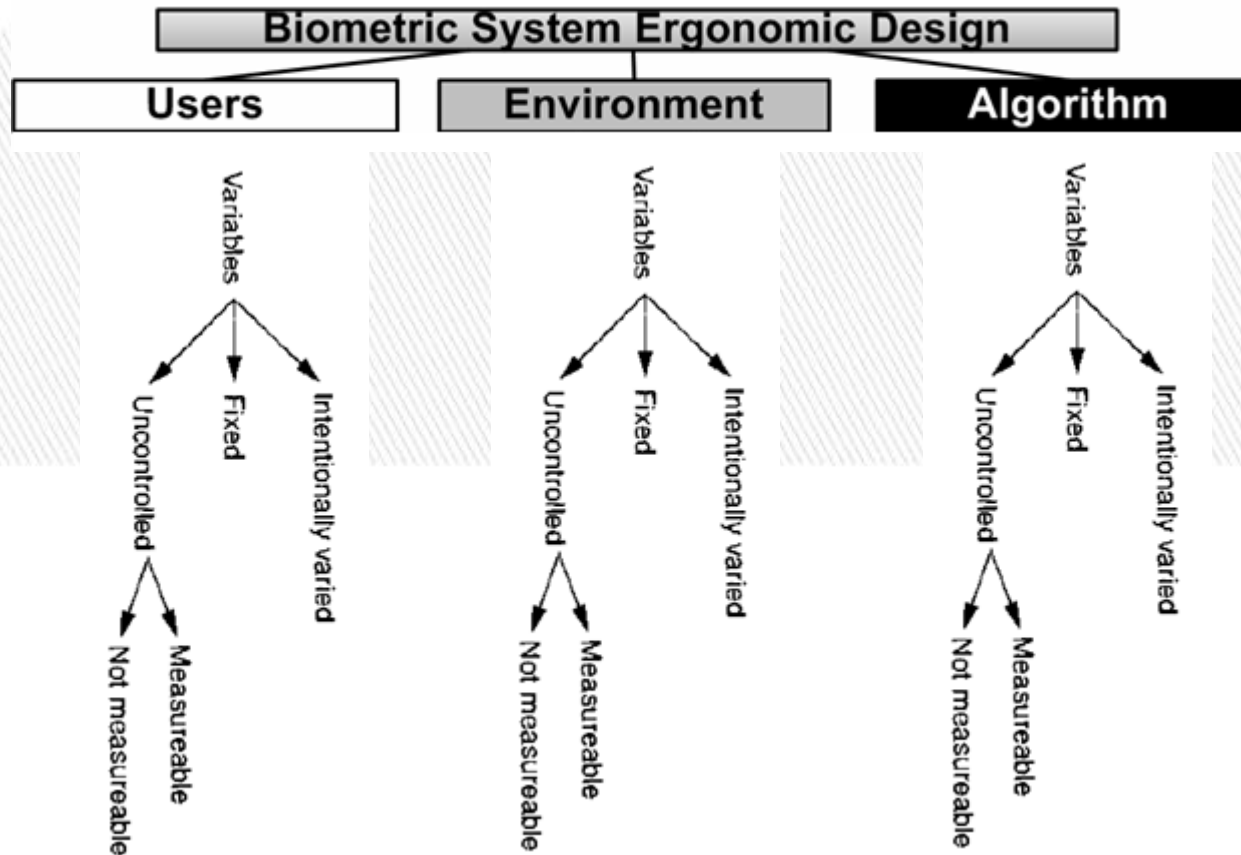
- The HBSI model is concerned with the data collection portion of the biometric model
 - Consistent and repeatable presentation to the sensor

HBSI MODEL



Conceptual model for HBSI

UNDERLYING MODEL



RESPONSIVE RELEVANT RESULTS

MODALITY TESTING AND HBSI

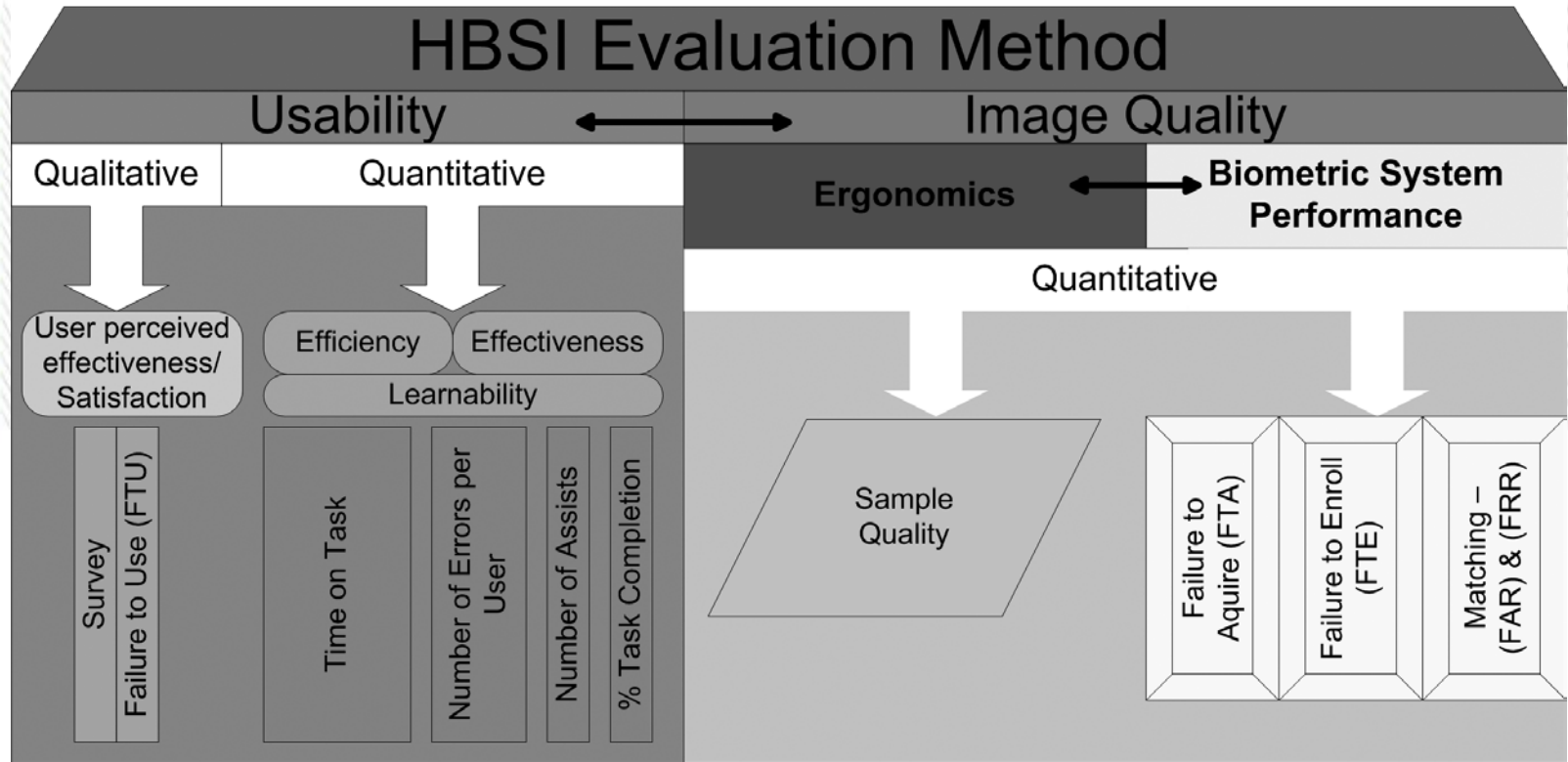
Year	Hand	Finger	Iris	Face	DSV
2004		Age	Mobile iris	Illumination	Different devices
2005	Co-Rec				
2006	Height /Placement				
2007	Habituation	Force			
2008		Gender			
2009	Initial HBSI Calc	Force Training			
2010			Fixed iris		
2011		Gender			Device (different sensors)
2012	Hand alignment	Force Finger interactions / Kinect	HBSI Training / Kinect	Detractors	Forgery
2012	Interaction Age	Interaction Age	Interaction Age	Interaction Age	Interaction Age

RESPONSIVE

RELEVANT

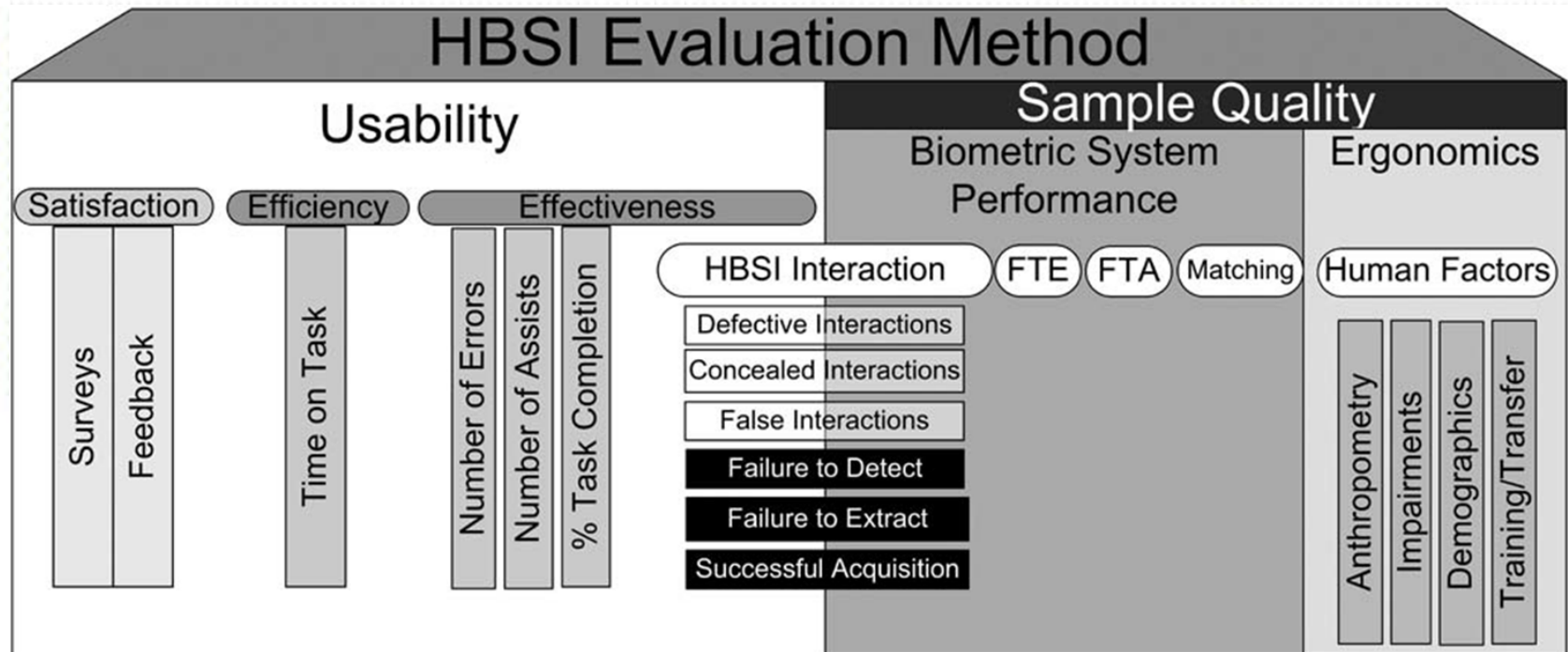
RESULTS

MODEL DEVELOPMENT - V1



RESPONSIVE RELEVANT RESULTS

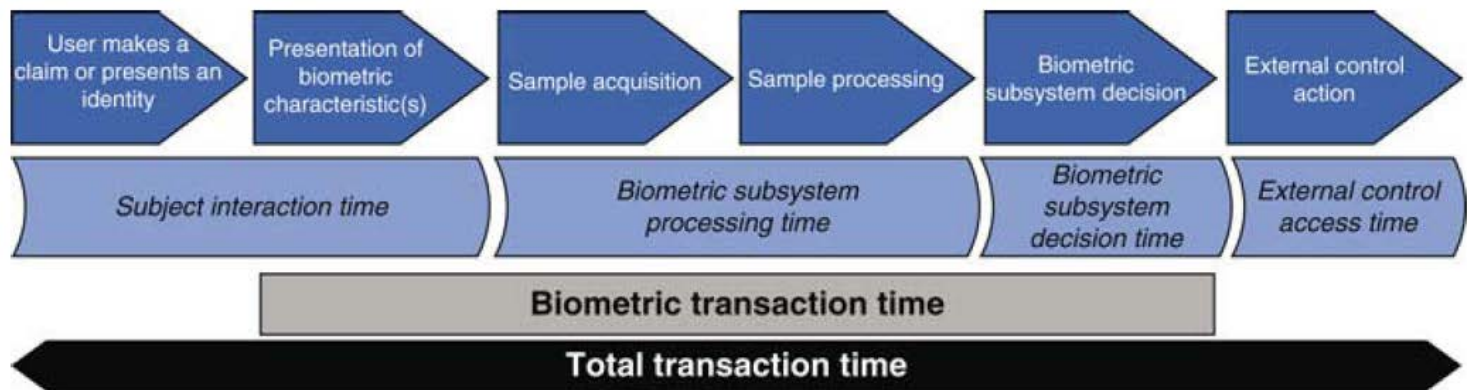
MODEL DEVELOPMENT - V2



RESPONSIVE RELEVANT RESULTS

INCLUSION OF OTHER MODELS

- General Biometric Model
- Operation Times Model (Lazarick, Kukula, et.al)



Operational Times. Figure 1 Types of transaction times.

TOTAL TRANSACTION TIME

Start of the Model

Present Biometric Characteristics

Failure to Process (FTP)

Failure to Detect (FTD)

No

User Interaction (Variable Length)

Defective Interaction (DI)

False Interaction (FI)

No

Acquire Sample

Presentation detected by biometric system?

Correct

Interaction correct?

Incorrect

Presentation detected by biometric system?

Yes

Yes

No

Presentation classified correctly by biometric system?

Yes

Successfully Processed Sample (SPS)

Process sample/biometric subsystem decision

HBSI (Human-Biometric Sensor Interaction) Model
(<http://www.bspalabs.org>)

Presentation classified correctly by biometric system?

Yes

No

Concealed Interaction (CI)

General Biometrics Model (Mansfield and Wayman 2002)

Data Collection Completed

Transmission
Compression
Transmission
Channel
ExpansionData Storage
Images
TemplatesSignal Processing
Segmentation
Feature Extraction
Quality Control
Pattern Matching

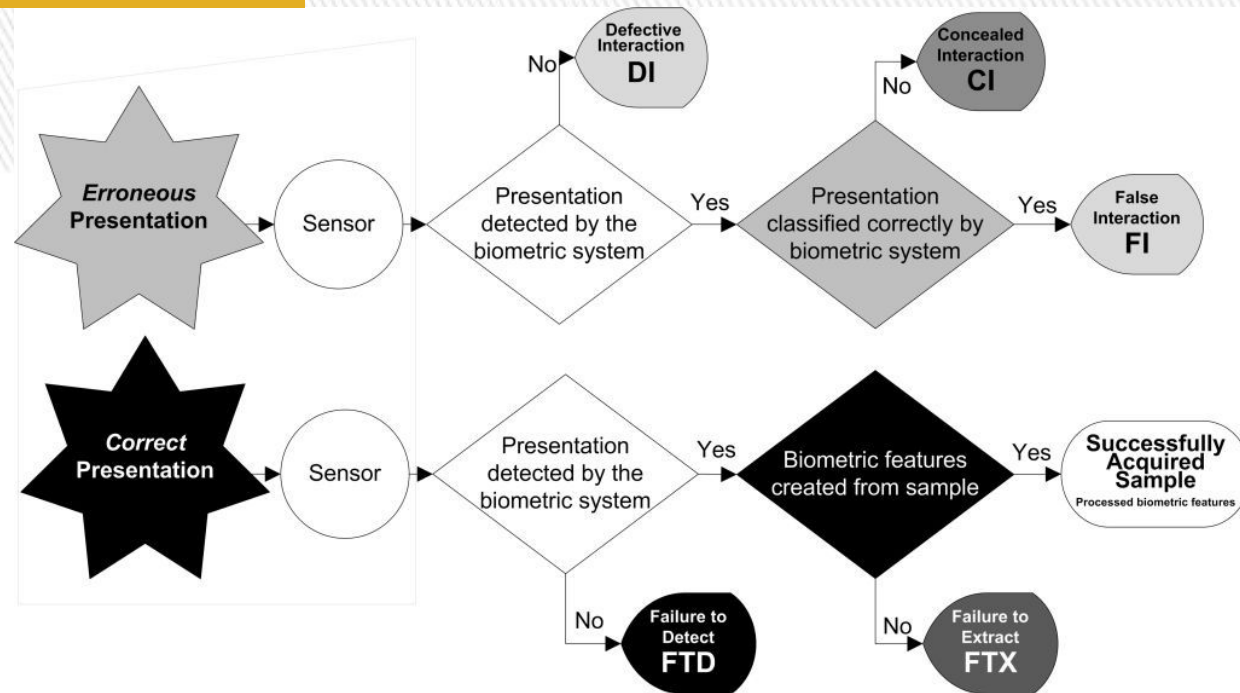
Below quality threshold?

BIOMETRIC TRANSACTION TIME

HBSI METRICS V2

Metrics created and validated for:

- Iris
- Fingerprint
- Signature Verification



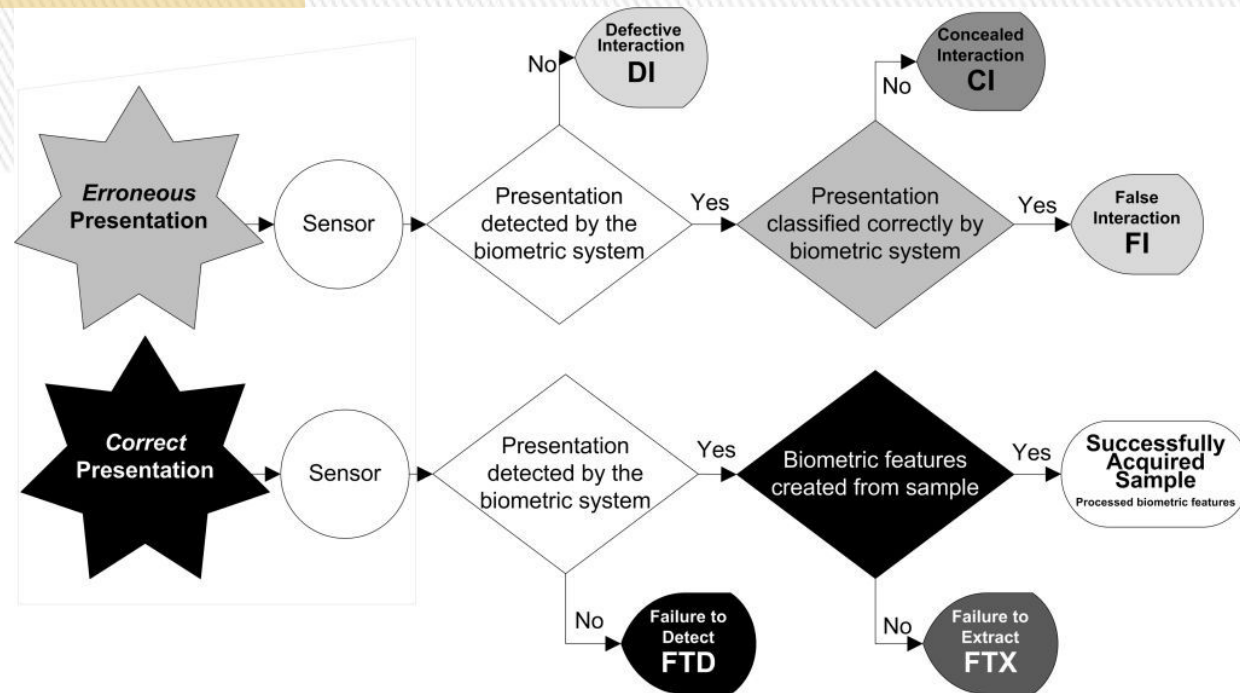
RESPONSIVE RELEVANT RESULTS

HBSI METRICS V2

Metrics created and validated for:

- Iris
- Fingerprint
- Signature Verification

Video record the environment from different angles in order to watch the subject and to classify their presentation
-typically 3 video angles and operator screen + (audio sometimes)



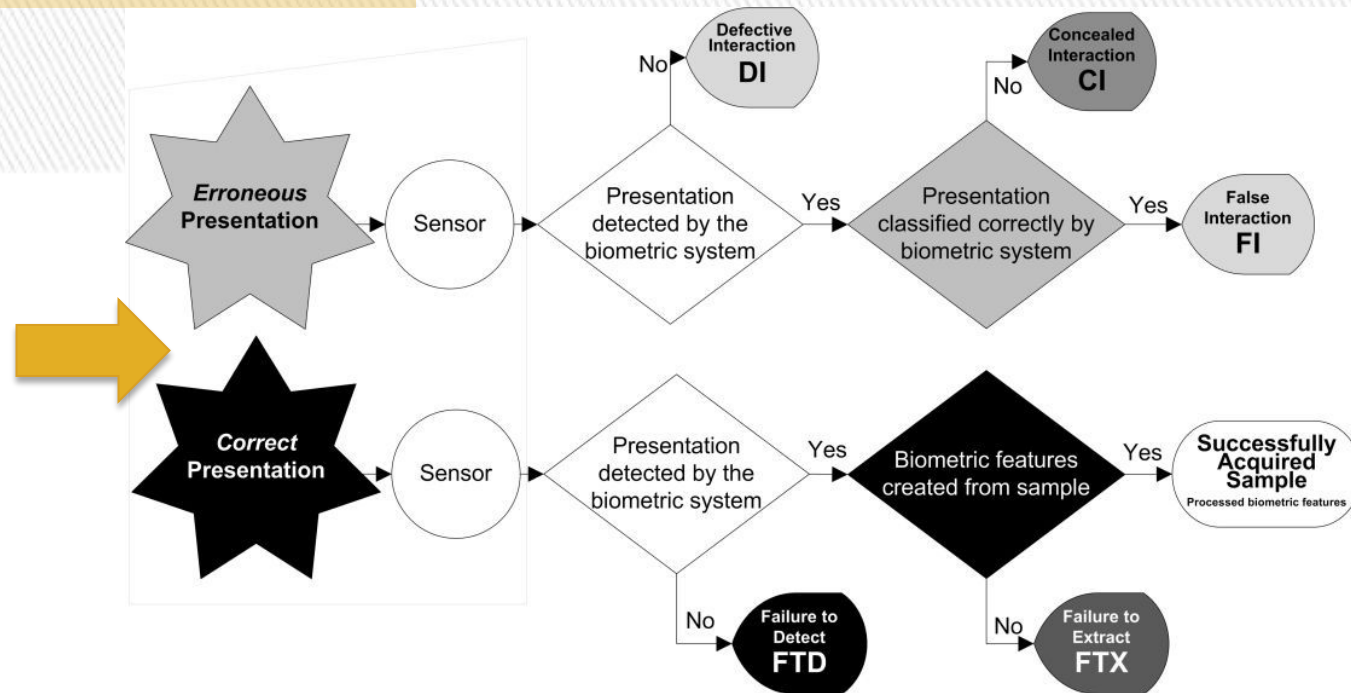
RESPONSIVE RELEVANT RESULTS

HBSI METRICS V2

Metrics created and validated for:

- Iris
- Fingerprint (different sensors)
- Signature Verification

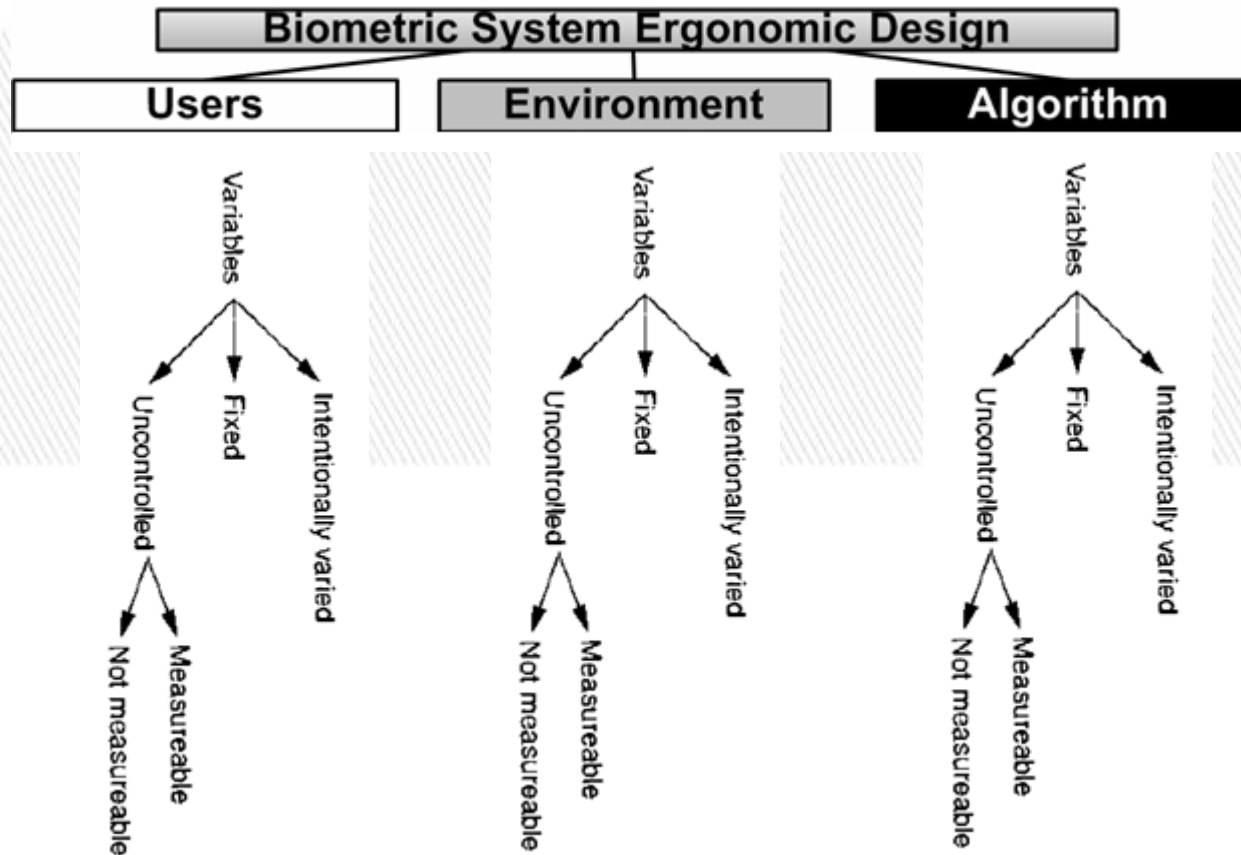
Record the environment (video and sometimes audio) from different angles in order to watch the subject and to classify their presentation
-typically 3 video angles and operator screen



RESPONSIVE RELEVANT RESULTS

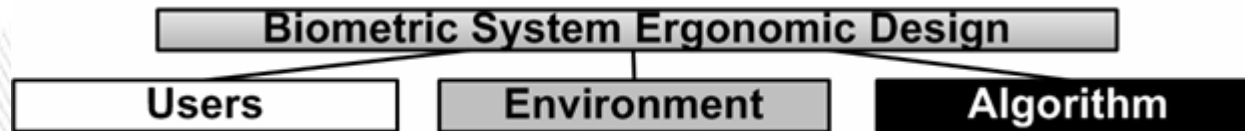
HBSI MODEL 3.0

UNDERLYING MODEL



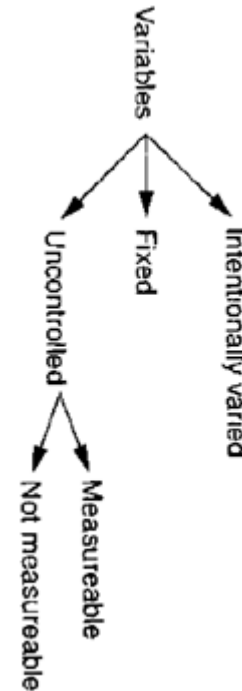
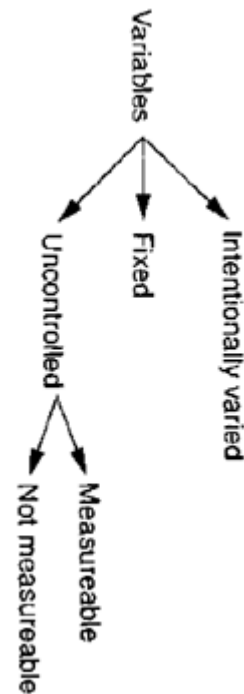
RESPONSIVE RELEVANT RESULTS

UNDERLYING MODEL EXAMPLES

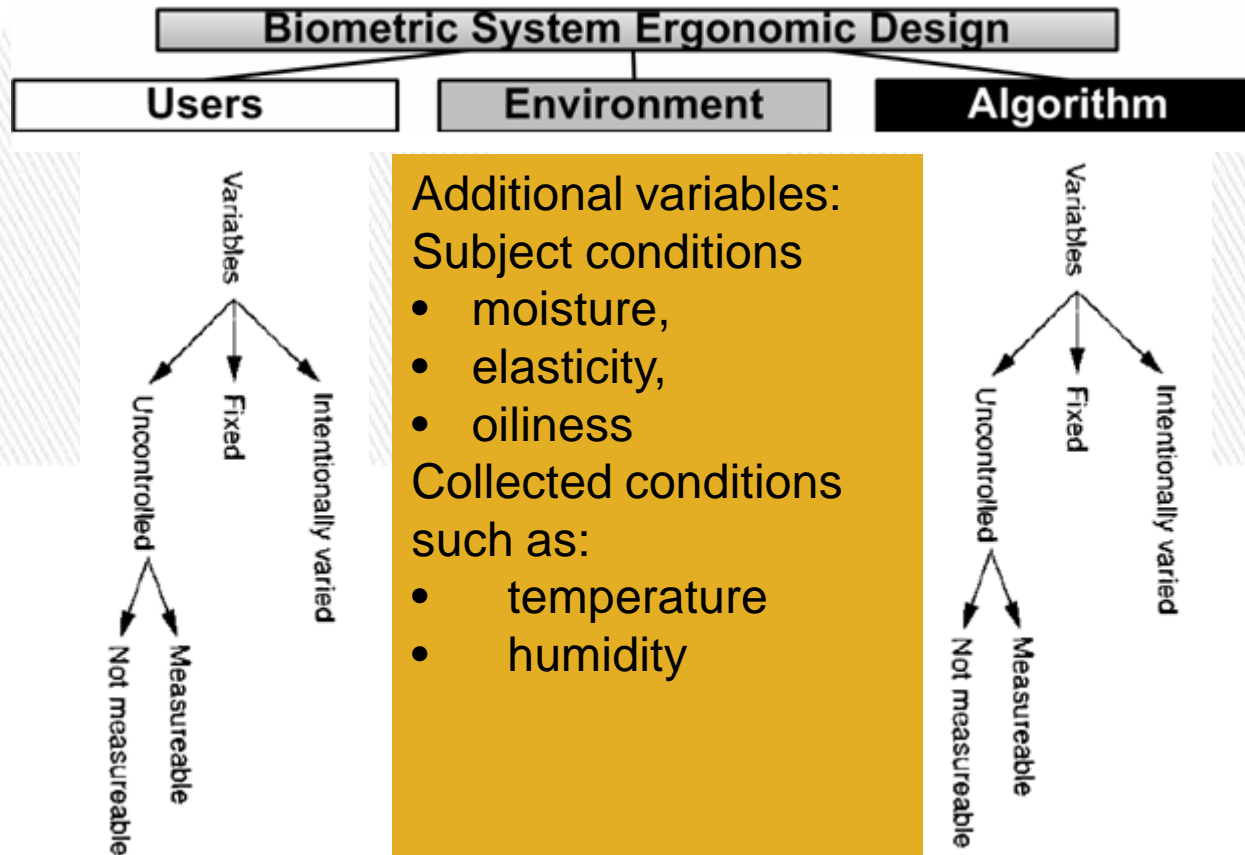


More actors:

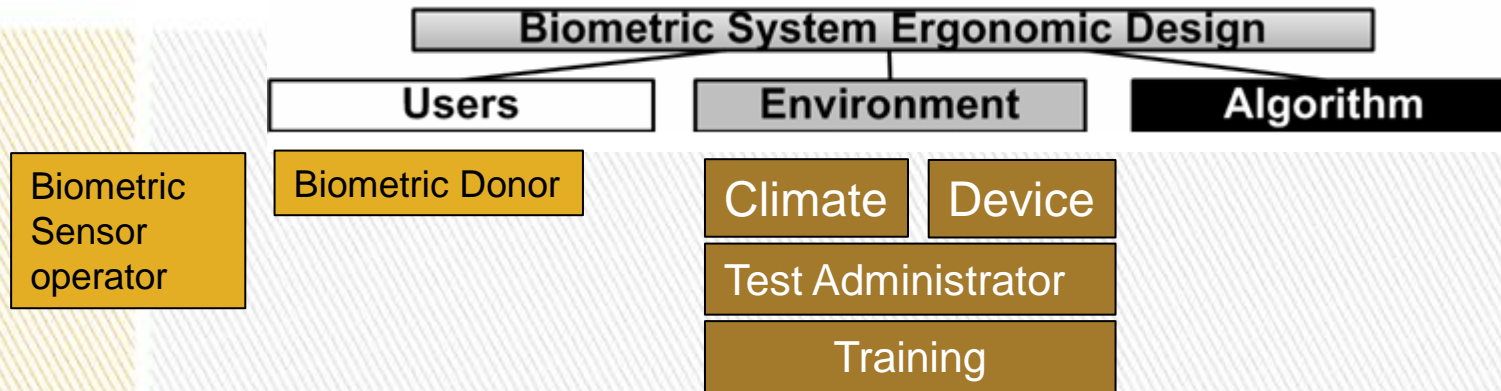
- Subject (typically the biometric donor)
- Operator
- Other people in the environment



UNDERLYING MODEL EXAMPLES

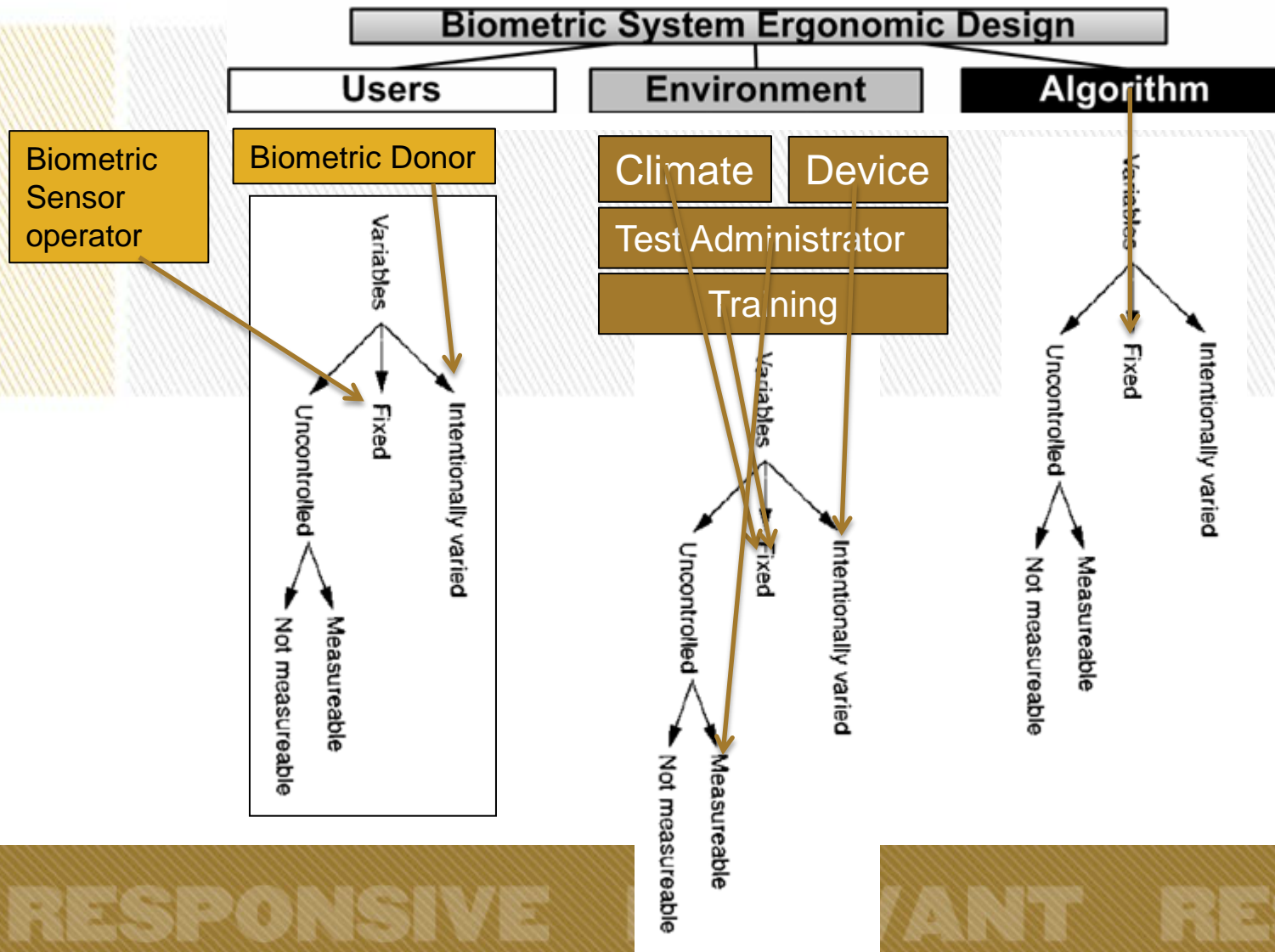


EXAMPLES: HAND GEOMETRY ACCESSIBILITY

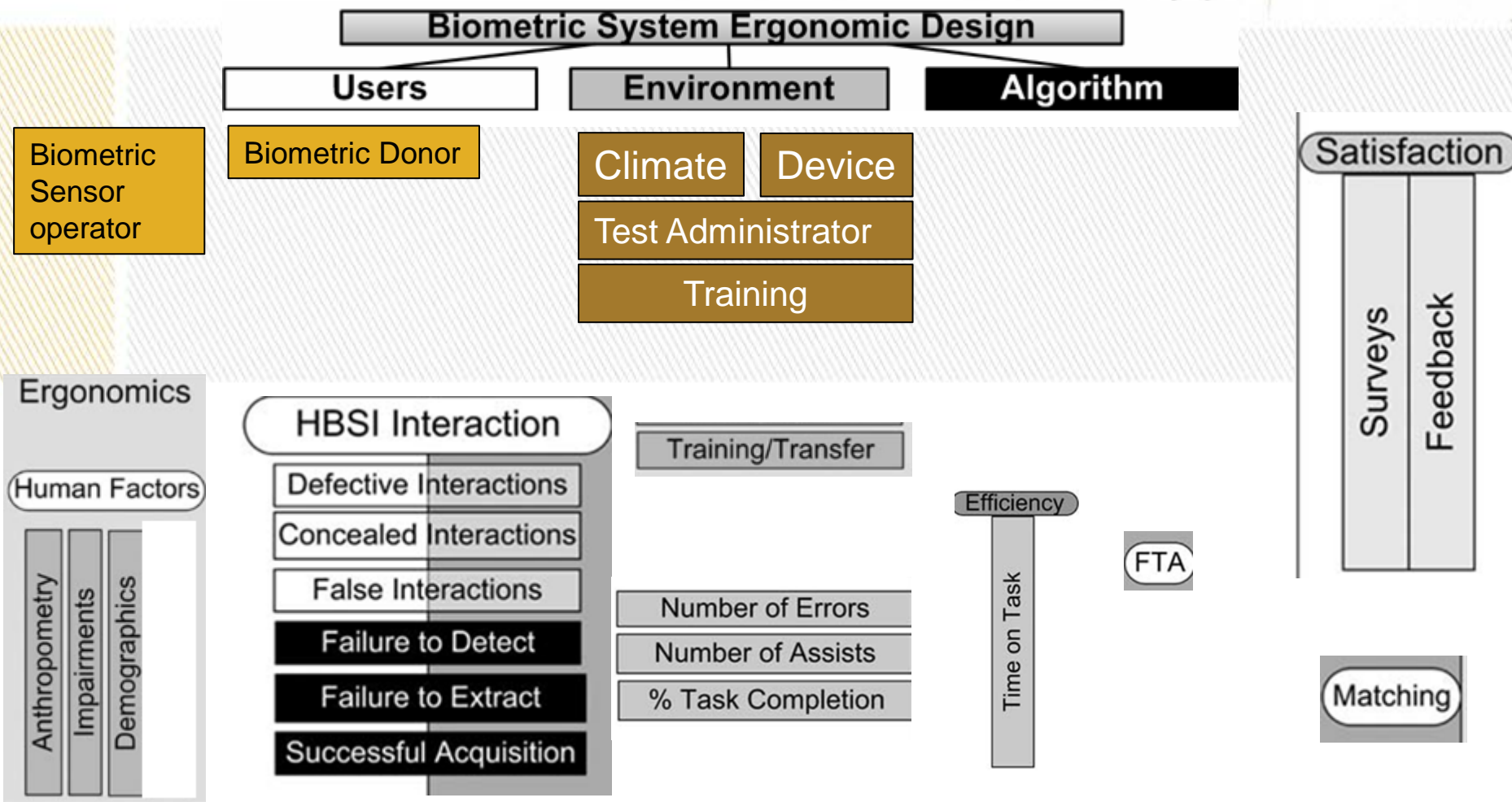


RESPONSIVE RELEVANT RESULTS

EXAMPLES: HAND GEOMETRY ACCESSIBILITY



EXAMPLE METRIC CALCULATIONS



RESPONSIVE RELEVANT RESULTS

DETERMINATION OF ERRORS V1

- Process:
 - Recorded in real time as the study is underway
 - Interactions are coded
 - Metrics of the evaluation model are completed
 - Interaction errors are classified as HBSI terms

CURRENT WORK

- Generation of the errors is time consuming
- We notice other potential errors
 - Contribution of the operator to the error
 - Contribution of the test administrator to the error
- HBSI workflow
 - Semi-automatic coding of the model using Kinect
- New work
 - Accessibility study – hearing and sight impaired (started Jan 2012)
 - Contribution of cost to the model (started Jan 2011)
 - Examining the role of the impostor (thinking As this model only has been rested in a “genuine” environment)
 - Development of products that can help improve interactions

ASSIGNING A COST MODEL

- Identify interaction issues
- Classify where these errors are occurring – what is causing this
- Assign a cost to “retry” for example – based on:
 - Poor interaction
 - Sensor feedback
 - Operator not paying attention
- Assess the impact on fixing this error

KINECT

CRAIG HEBDA | ROB PINGRY | WENG KWONG CHAN |
BRENT SHULER

RESPONSIVE

RELEVANT

RESULTS

MOTIVATION

- Video coding is time consuming
- Inter-rater reliability
 - Requires good robust definitions

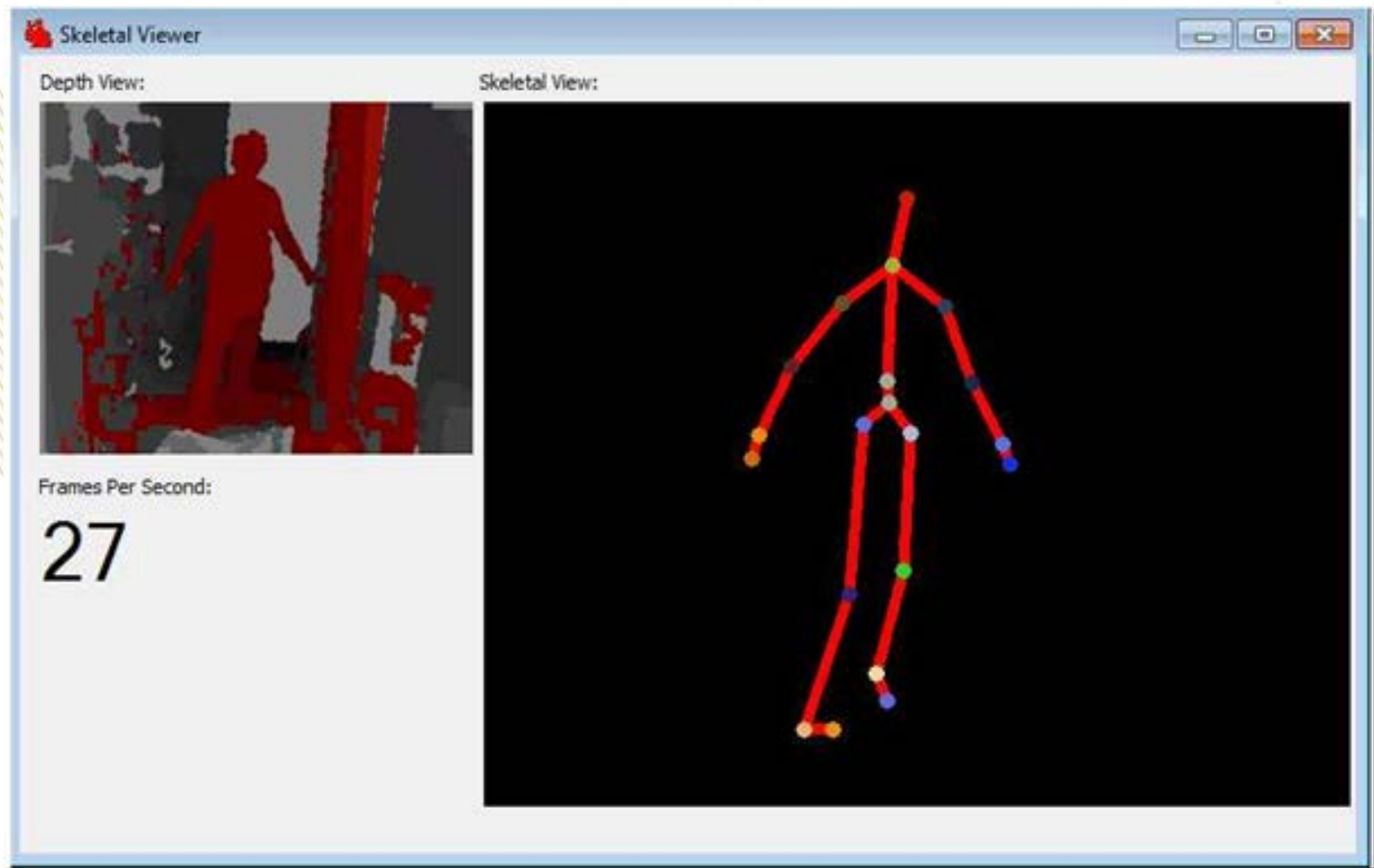
DEFINING MOVEMENT

Jake Hasselgren (2011)

Slouched:	Subject is not standing up straight during fingerprint scan.
Head Movement:	Subject's head is not still during fingerprint scan.
Body Movement:	Subject's body is not still during fingerprint scan.
Upright:	Subject is standing up straight during fingerprint scan.
Labored Walking:	Subject has bag or other item on shoulder when approaching device
Pivoting Palm:	Subject's hand pivots on edge of device
Rocking Fingers:	Subjects fingers rock from one finger to the next when hand is placed on device
Slapping Hand:	Subject slaps hand on to the device
Angled Fingers:	Subjects fingers are at an angle other then 90 degrees from edge of the device

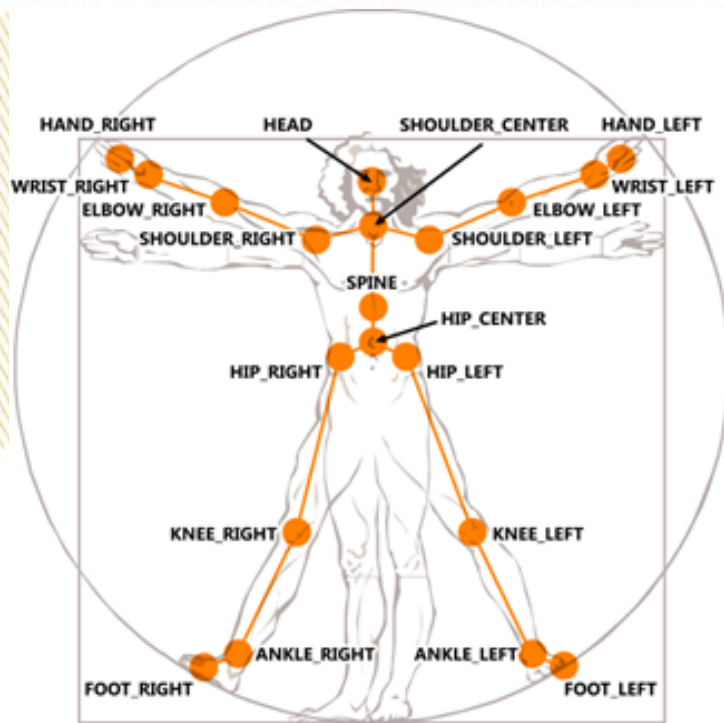
RESPONSIVE RELEVANT RESULTS

MICROSOFT ® SDK INTERFACE

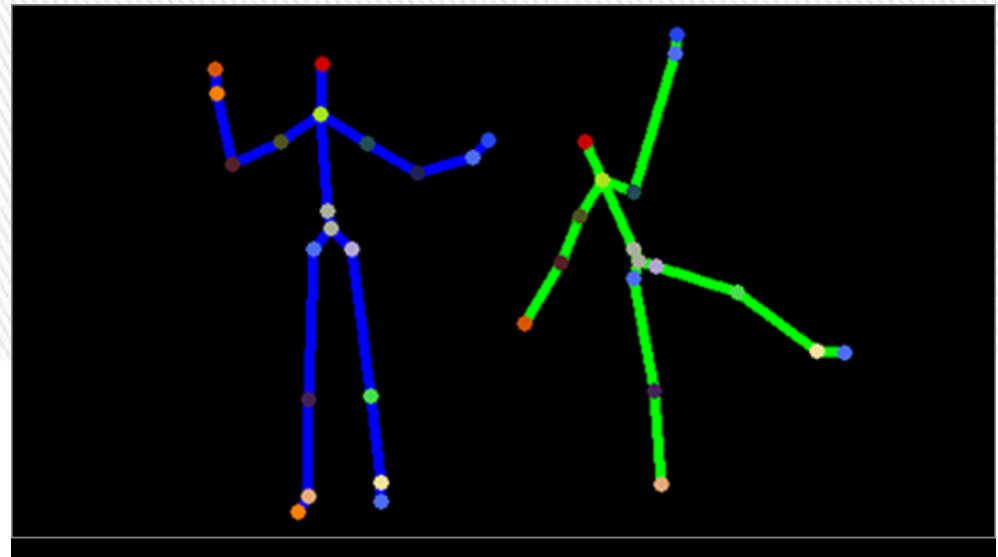


RESPONSIVE RELEVANT RESULTS

MICROSOFT® KINECT™ SKELETAL TRACKING SYSTEM



Source: <http://msdn.microsoft.com/en-us/library/hh438998.aspx>



Source: <http://www.genbetadev.com/herramientas/disponible-el-sdk-de-kinect-para-desarrollar-nuestras-propias-aplicaciones-usando-los-sensores>

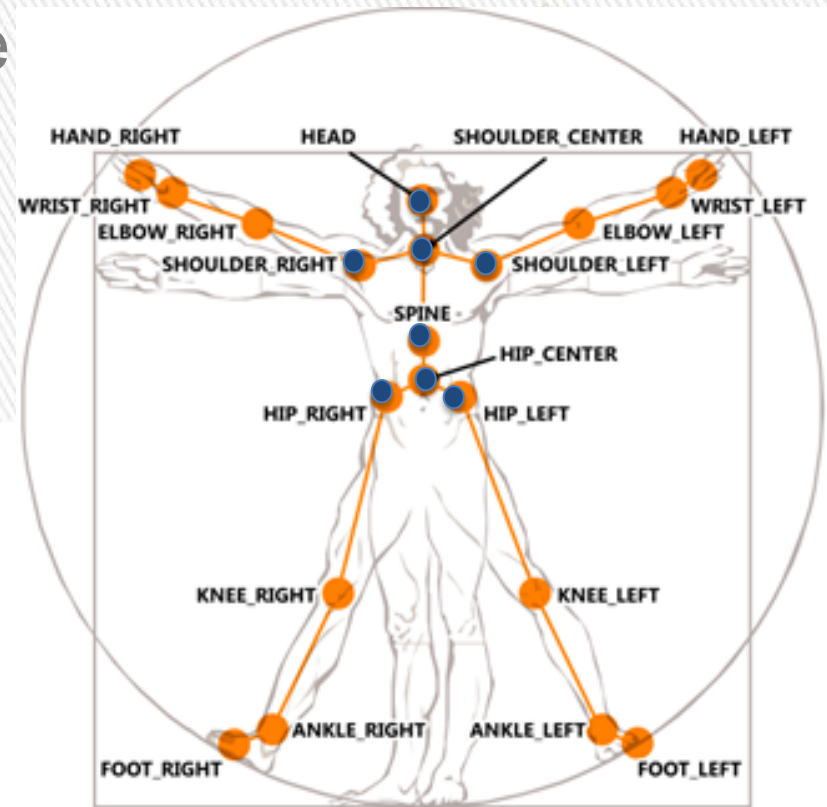
SLOUCHING

- Dictionary Definition
 - Slouching-A gait or posture characterized by an ungainly stooping of the head and shoulders or excessive relaxation of body muscles.
- Points of interest:
 - -Shoulders
 - -Head
 - -Spine
 - -Hips

Source: <http://www.merriam-webster.com/dictionary/slouch>

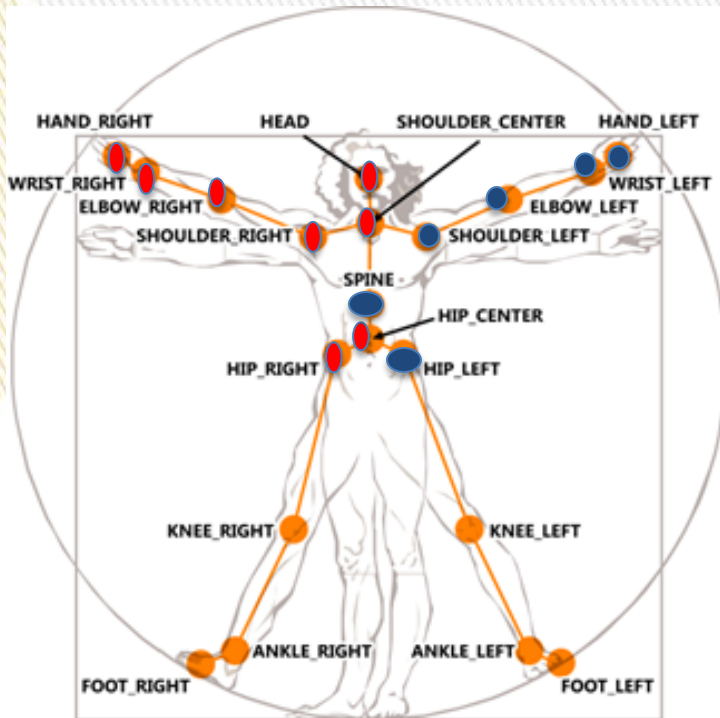
SLOUCHING

- Tracking Points to be
 - Shoulder_Right
 - Shoulder_Left
 - Shoulder_Center
 - Head
 - Spine
 - Hip_Center
 - Hip_Right
 - Hip_Left



SLOUCHING

Highlight what is
slouching
Break it into left right



• Left Slouching:

- Left shoulder will be lower than the right shoulder.
- All points on left arm will be lower than base image.
- Head will be tilted to left.
- Left hip will be lower than right hip.
- Spine point will move slightly up and right.

● =Movement Up
● =Movement Down

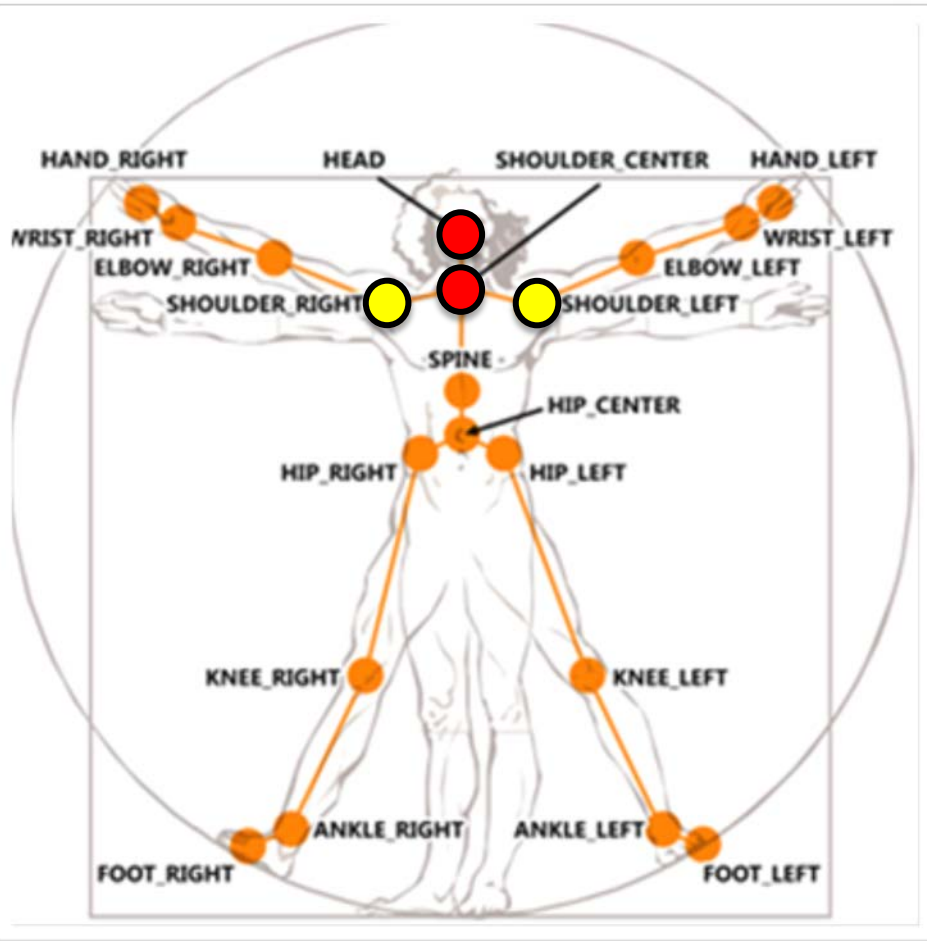
SOLUTIONS TO THE CHALLENGES OF DEFINING

- A multi point approach can help solve the majority of the problems when describing what is slouching.
- Use a combination of how much each point moves to determine if the subject is slouching or just moving one part of their body.

HEAD DISPLACEMENT

- **Definition of Head Movement:**
- Voluntary or involuntary motion of head that may be relative to or independent of body.
- <http://www.medical-dictionary.cc/what-does/head-movement-mean>

HEAD DISPLACEMENT



Critical Tracking Points (TPs):

1. Head (H)
2. Shoulder_Center (SC)



Associated Tracking Points (TPs):

1. Shoulder_Right (SR)
2. Shoulder_Left (SL)

DEFINITION OF HEAD MOVEMENT BASED ON TRACKING POINTS

Head Movements	Tracking Points Definition	Changes in Coordinates
Lowering head	H approaches SC	X, Y, maybe Z too
Nodding	H moves back and forth from SC repeatedly	X, Y, maybe Z too
Head turning	Turn to the left: H moved to the left	X, Y, Z
	Turn to the right: H moved to the right	
Head tilted to one side	Tilt to the left: H moved to the left	X, Y
	Tilt to the right: H moved to the right	
Head bobbing	H moves in random direction with minimal distance	X, Y, Z
Head sliding forward	H moves forward	Z
Head wagging	H moves in left and right rapidly	X, Y

Source: <http://www.thefreedictionary.com/Head+Movements>

HOW WILL THIS WORK?

A QUICK ROADMAP



Observation of
error

Automatic
identification
and
classification of
error


Feedback to
the user,
customized to
their interaction
error

RESPONSIVE RELEVANT RESULTS

ACTIVITIES

- Link behavior and interaction to the image
- Understand the basic performance characteristics
- Relay back whether the interaction (or change in interaction) affects performance



Project	Sample	Person	Enviromental	FingerStats	MOET	FourForce	Survey	Anthropometric
LocatorNum	45051							
SampleSet								
VisitNum	1							
SubjectID	1							
SampleID								
FileName	1_2.tif							
File Path	file:///C:/							
Image								
FileType	.tif							
FileSize	145624							
Modality	Fingerprint							
SensorID								
isCapture								
ForceLevel								
CaptureStartTime								
CaptureStopTime								
Process Time								
Modality Subtype								
ImageExists	OK							

The benefit is to examine the information associated with the sample, but also the video interaction of the image.

HBSI V3 has (will have):

- video and audio interaction
 - Watch the interaction
 - Understand who is contributing the error
 - Replay the interaction in real time as it was collected
- Metadata collected and searchable

QUESTIONS?

Get Involved in shaping these projects – contact elliott@purdue.edu to participate in the development of the model

Teleconferences over the summer 2012 period

- Other actors
 - Contribution of the operator to the error
 - Contribution of the test administrator to the error
- HBSI workflow
 - Semi-automatic coding of the model using Kinect
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ADDITIONAL SLIDES

RESPONSIVE RELEVANT RESULTS