Deception Detection Techniques for Rapid Screening

Dr. Jay F. Nunamaker, Jr.

Director, National Center for Border Security and Immigration

Regents and Soldwedel Professor of
MIS, Computer Science, and Communication

University of Arizona

Why Study Credibility Assessment?

- **Humans are poor lie-detectors**
  - **~54% accuracy rate for general population**
  - **Accuracy deeply affected by base rates**
  - **Poor performance affects novices and professionals**

- **Confidence in judgment is not correlated with accuracy**
  - **Affects attentiveness, verification efforts, and misallocation of resources**

Improving Human Detection

- **Detection accuracy rates may improve with:**
  - **Training**
    - **Mixed results, but generally significant positive effect**
  - **High stakes scenarios**
    - **Detection in criminal interviews approaches 80% accuracy**
    - **However, the linkage between motivation and deception performance is currently being debated**
  - **Familiarity with individual's usual behavior patterns (baseline)**

Problems for Humans to Overcome

- **Excessive focus on nondiscriminant or a small subset of cues**
  - **Gaze aversion**
  - **Nervous gesturing**
  - **Preening**
- **Vigilant observation**
  - **Attention required for multiple channels**

Border Crossing Environment

Border Scenario

Test Your Skills!

Results

- **Fluid motion**
- **Resonant voice**
- **Spontaneous positive affective displays**

Border Scenario

Test Your Skills!

Results

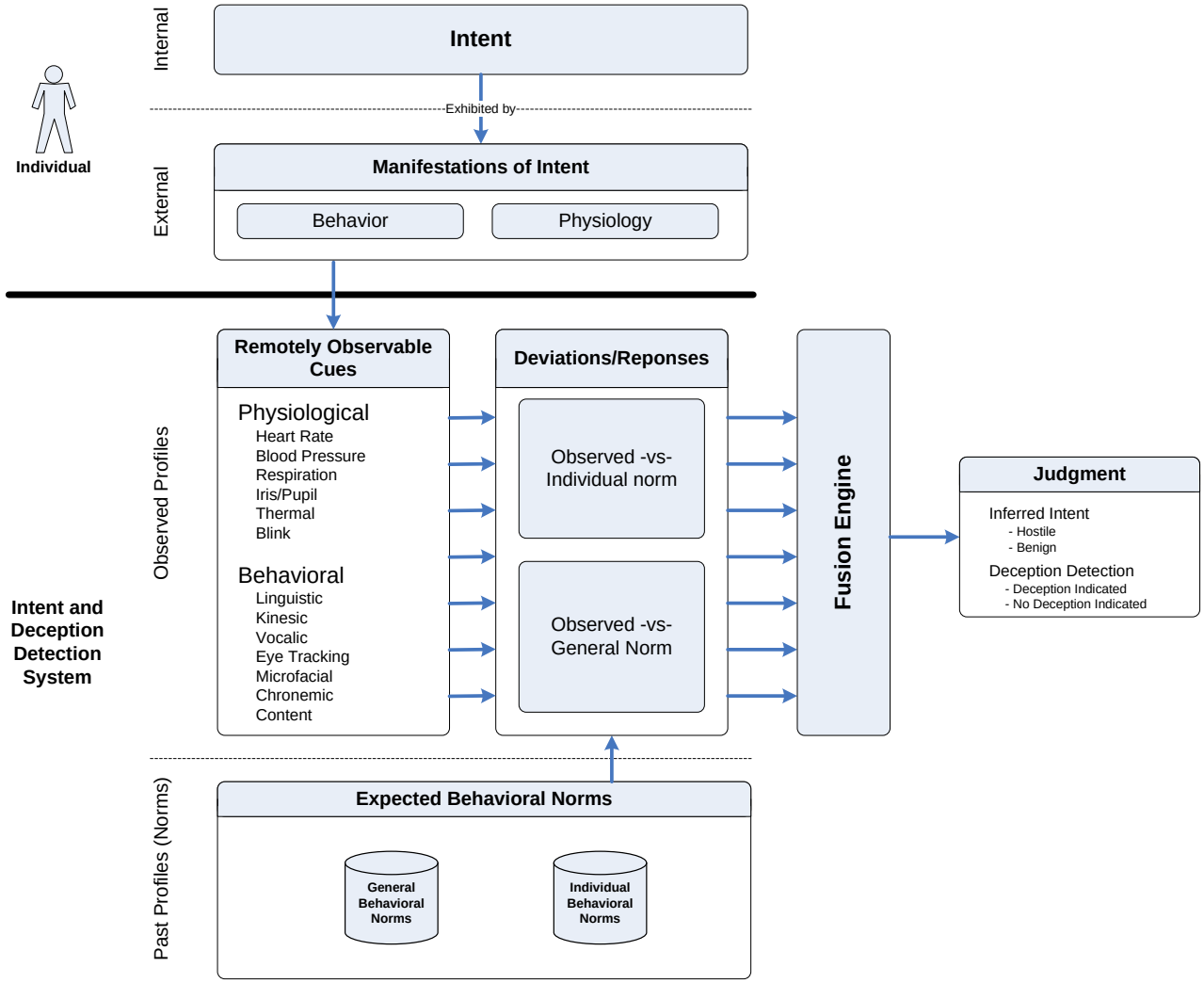
- Rigid during non-speech, abrupt during speech
- Elevated voice frequency
- Submissive responses
  - Low gain
  - Signs of deference
- Negative affective displays
  - Perhaps in response to agent
- Various contextual cues

Research Purpose

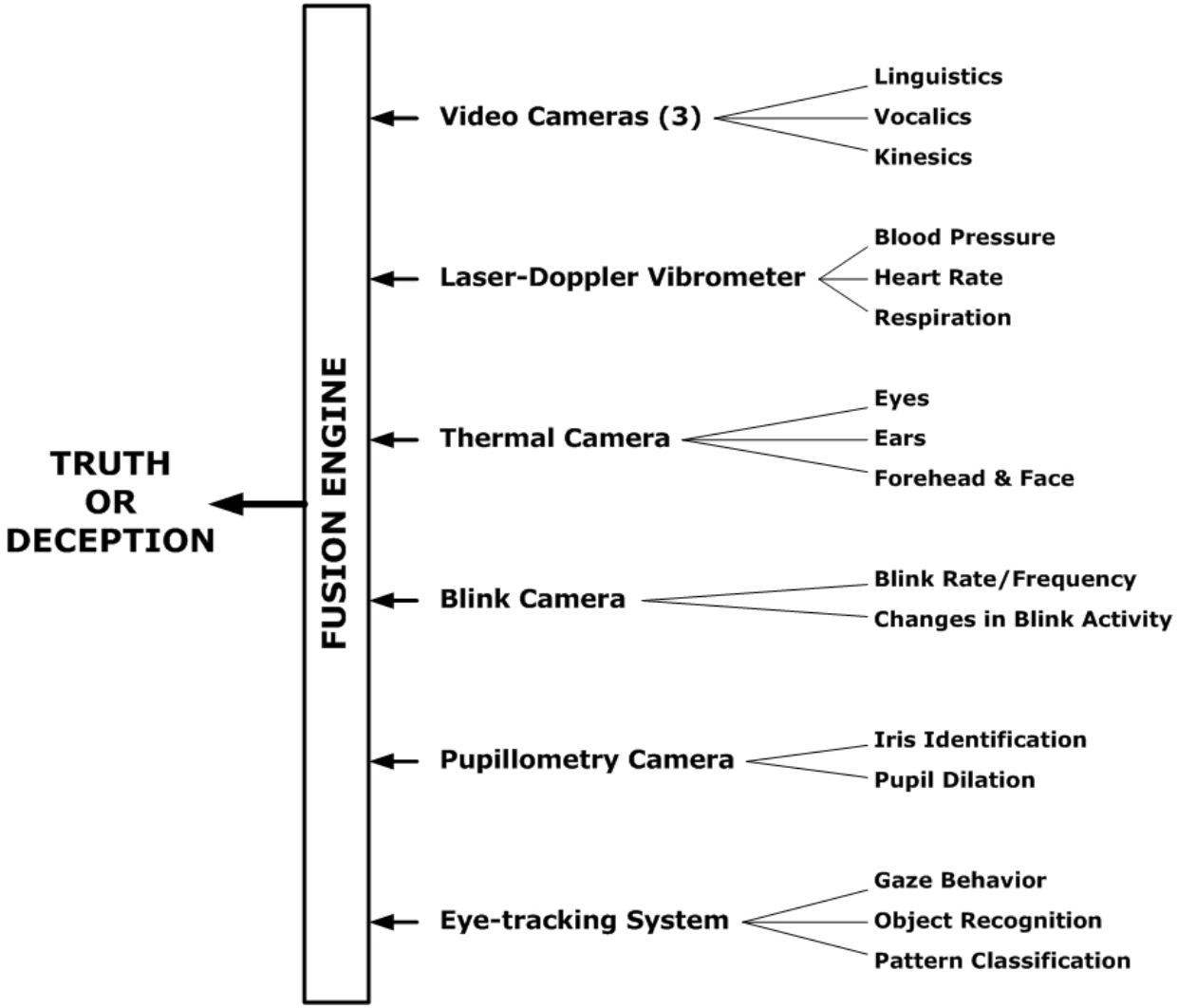
- **Unobtrusive credibility assessment and intent detection**
  - **No sensors attached to the body**
  - **Real-time, remote analysis**
  - **Scalable and robust for high traffic**
  - **Useful across contexts**

- **Investigating technologies to augment/replace the polygraph**

Research Approach



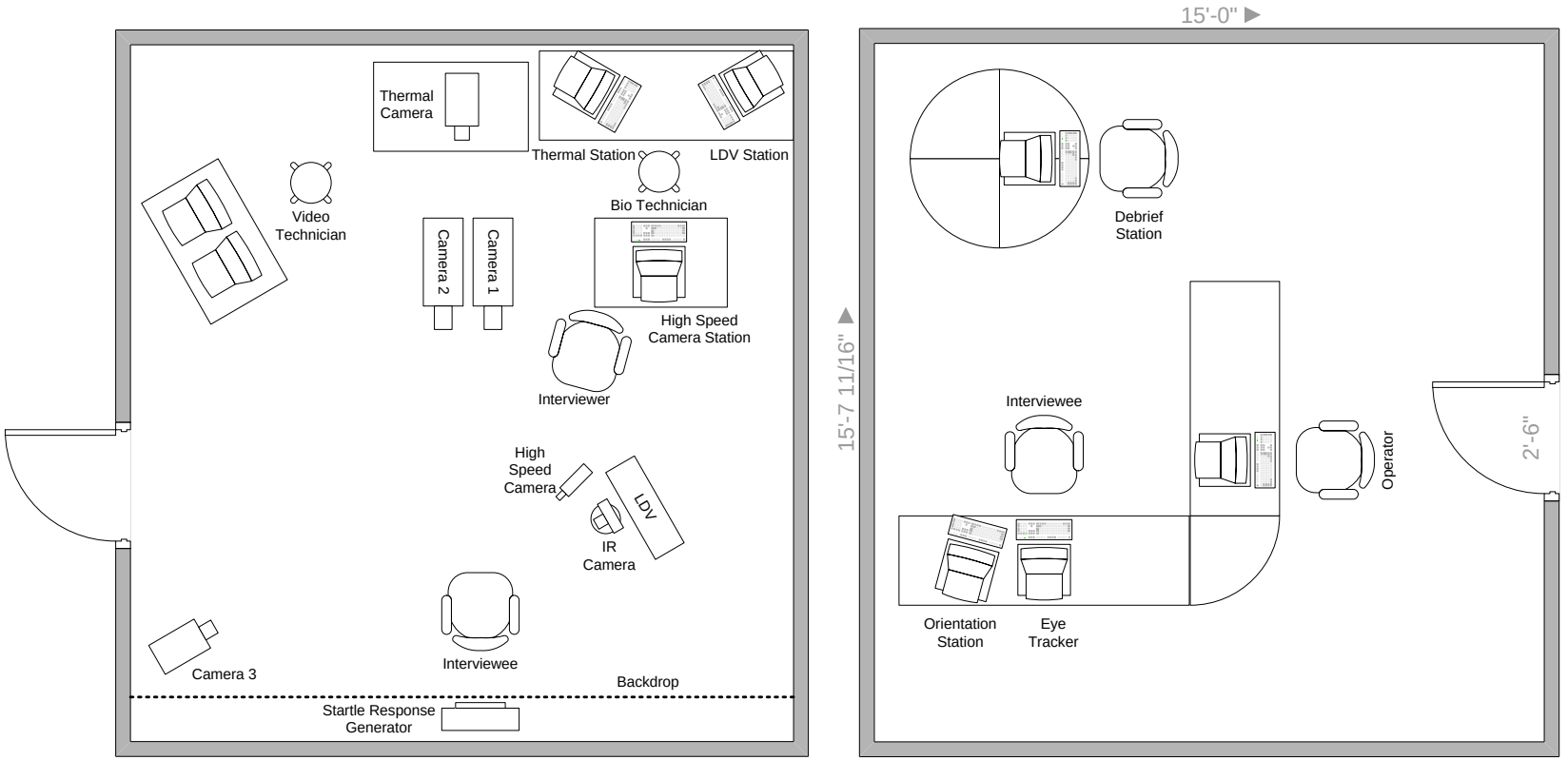
Non-invasive Credibility Assessment



Approach for Multimodal Credibility Assessment Validation

- **Multi-institution research program**
- **Multi-method approach**
  - **Prototype development**
  - **Field studies**
  - **Laboratory studies**
  - **Surveys**
- **Over 4600 subjects**

Laboratory Layout



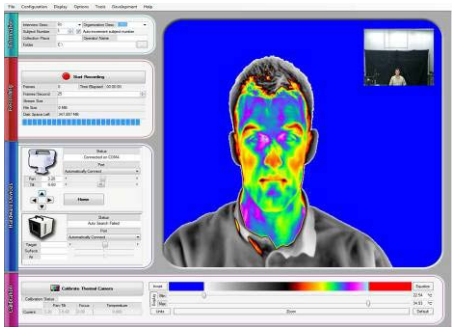
Experiment Lab setup

Credibility Assessment Devices

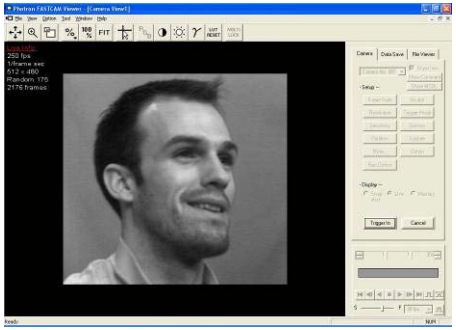
(Provided by DACA – Defense Academy for Credibility Assessment)

LDV

THERMAL



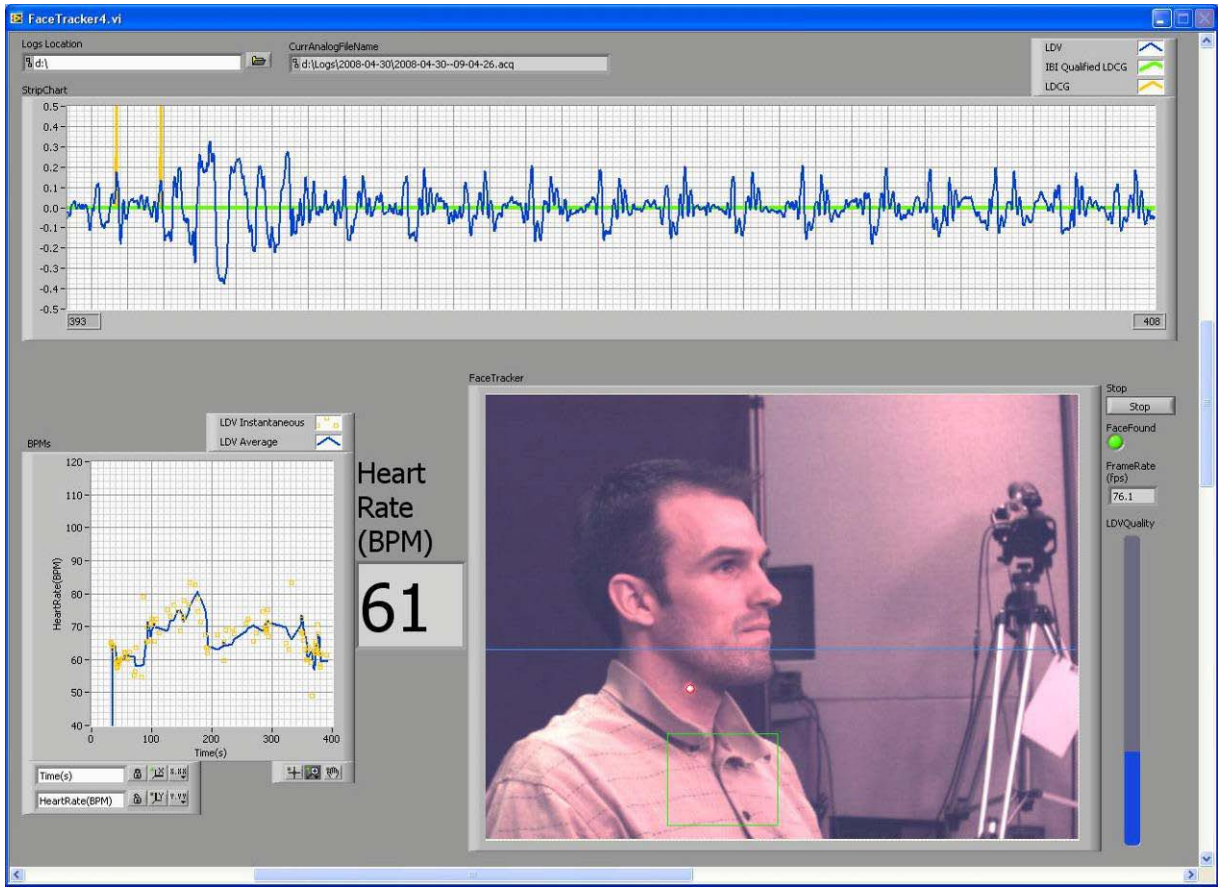
BLINK

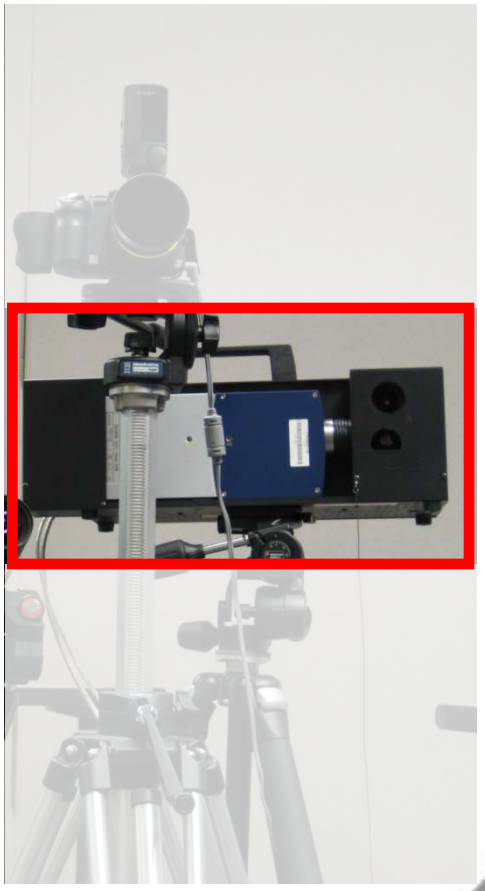


PUPILLOMETRY

EYE-TRACKING

Laser-Doppler Vibrometry





Laser-Doppler Vibrometry

- Uses a laser pointed at the carotid artery
- Tracks minute changes/movement in the artery
- Can remotely track pulse and blood pressure
- Currently exploring other identifiable physiological features
  - Respiration
  - Muscle tension
  - Artery stiffness

Laser-Doppler Vibrometry

Operational Benefits and Drawbacks

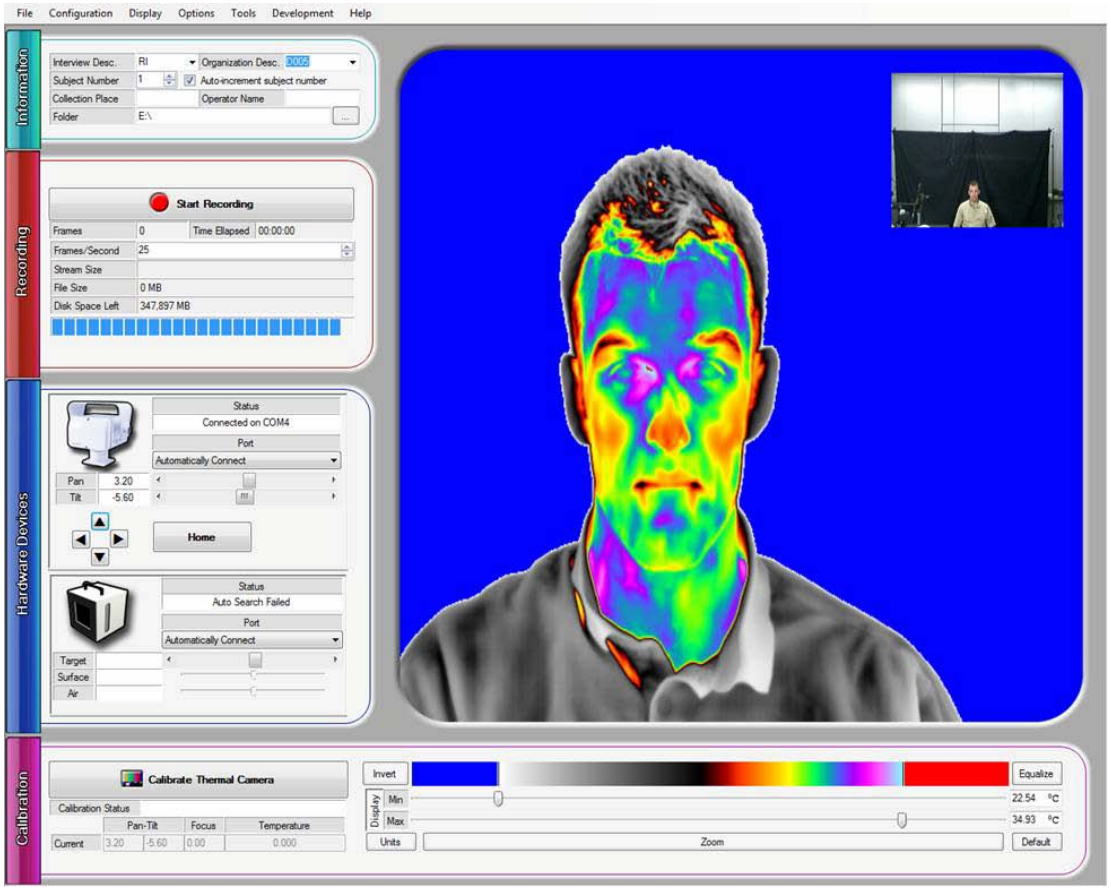
Benefits

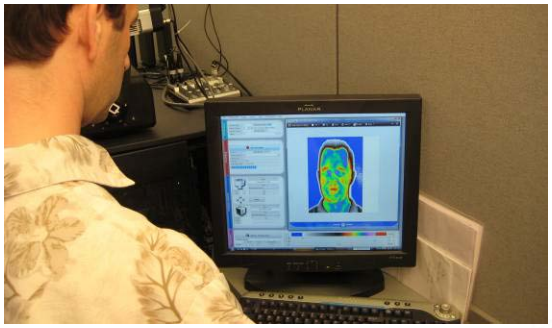
- For use with screening questions
  - No narrative responses
- Tracks well known physiological features

Drawbacks

- Noise introduced by speaking, movement, etc.
- Small target area

Thermal Video Imaging Technology





Thermal Video Imaging Technology

- Uses a thermal camera
- Tracks minute changes in skin temperature
- Can identify increase blood flow to the brain
- Arousal signature shows as a temperature plume in the lower forehead and between the eyes

Thermal Video Imaging Technology

Operational Benefits and Drawbacks

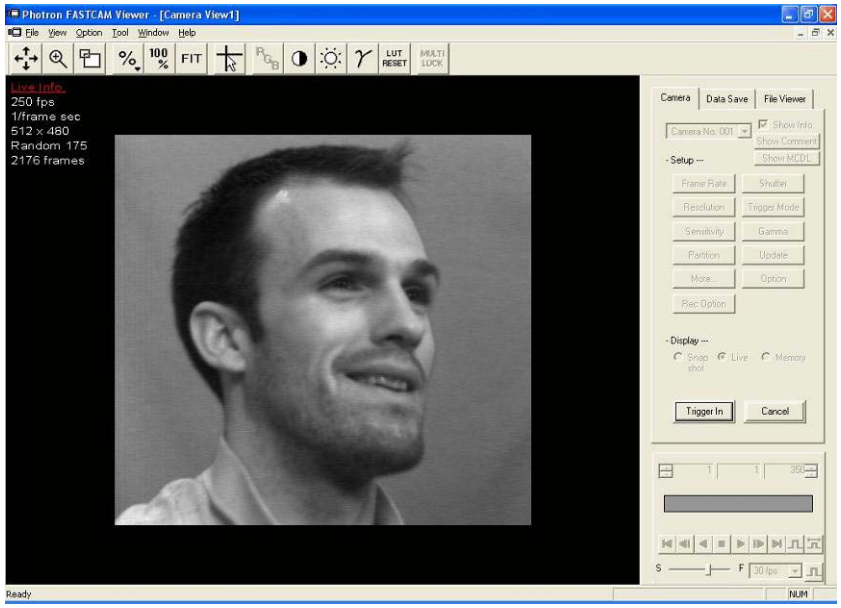
Benefits

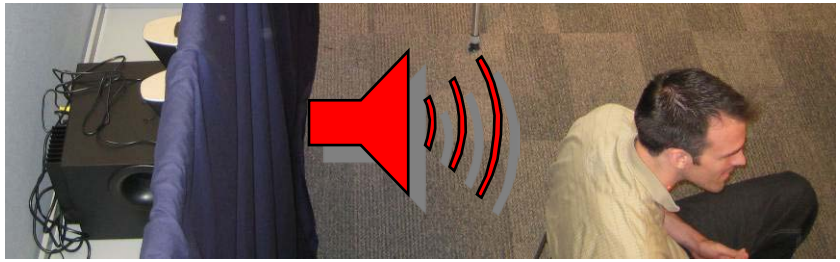
- For use with screening questions

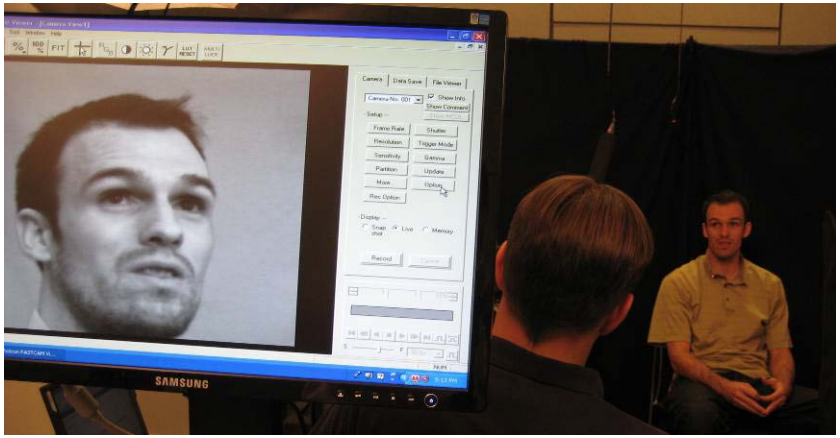
Drawbacks

- Expensive
- Noisy equipment
- Time intensive calibration
- Sensitive to environmental changes
- Data intensive

High-speed Blink Imaging Technology







High-speed Blink Imaging Technology

- Uses a high speed camera (~250 fps)
- Tracks blink responses to questions

High-speed Blink Imaging

Operational Benefits and Drawbacks

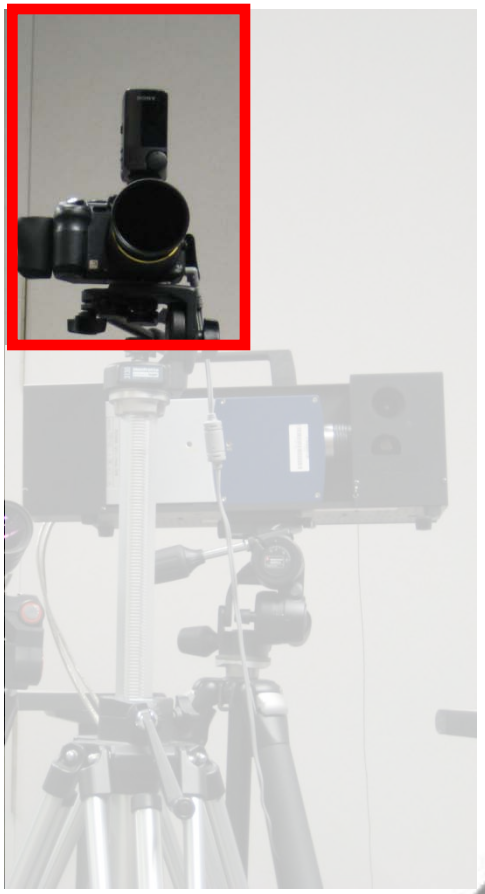
Benefits

- For use with screening questions

Drawbacks

- Used with a startle generator
  - Can be unwieldy during an interview
- Data intensive

Pupillometric Video Imaging Technology



Pupillometric Imaging Technology

- **Uses an IR camera to track pupil dilation**
- **Deceptive responses correlate with pupil dilation**

Pupillometric Imaging Technology

Operational Benefits and Drawbacks

Benefits

- For use with screening questions
- Brief responses need be measured

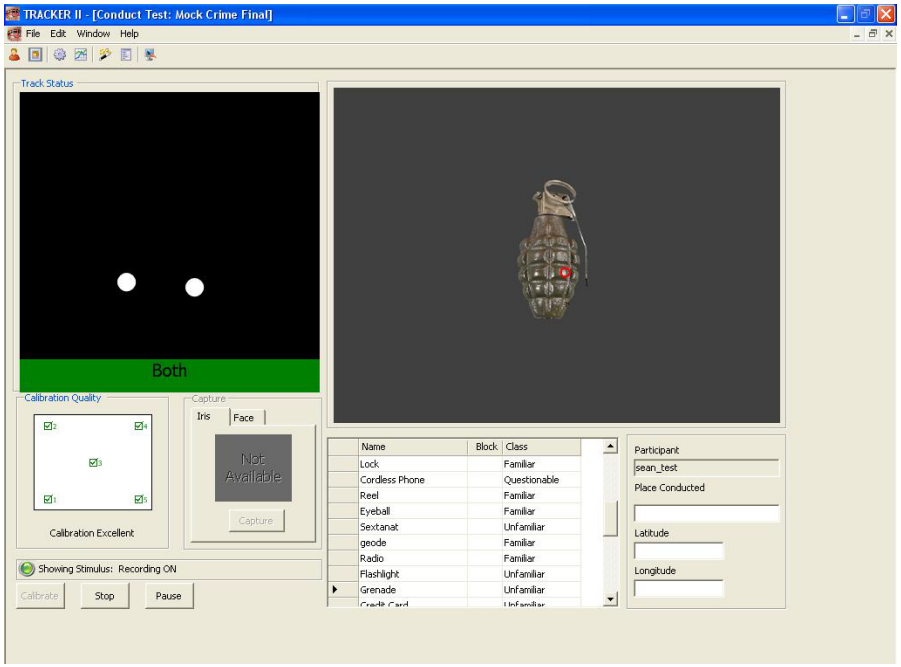
Drawbacks

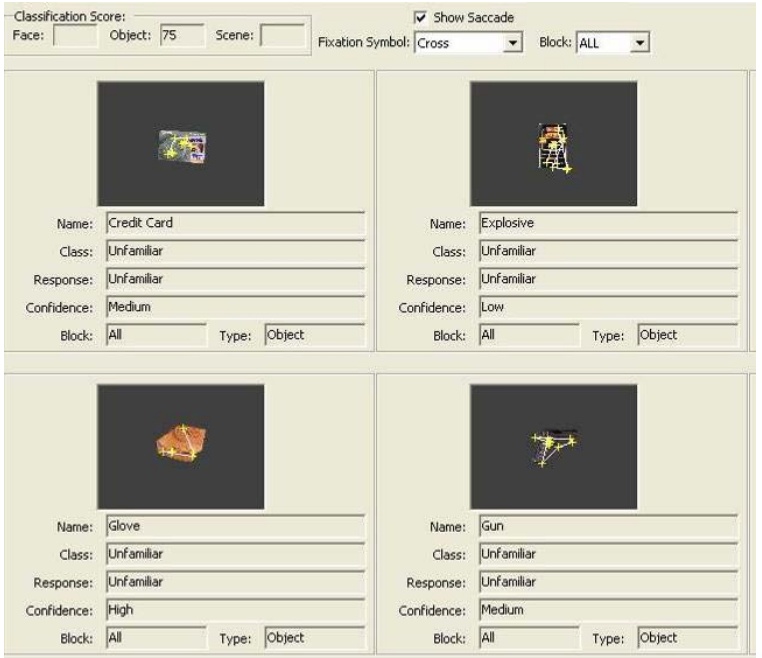
- Sensitive to noise
- Most diagnostic when subject is stationary
- Requires unobstructed view of eyes

Eye-tracking Systems

- **Uses multiple IR cameras**
- **Tracks search patterns as participant views an image**
- **Can separate familiar images from unfamiliar images**

Eye-tracking Systems & Applications





Eye-tracking Systems

Operational Benefits and Drawbacks

Benefits

- Deployable system
- Non threatening interaction
- Immediate feedback

Drawbacks

- Requires guilty knowledge
- Requires subject cooperation
  - Calibration
  - Proper scanning of images
- Tracking not possible with all subjects

Embodied Avatar Kiosk

Rapid Deception Assessment Screening

- **Mission**
  - Rapid, automated deception assessments using kiosk-based embodied avatars and intelligent agents
- **Objectives**
  - Identify deception cues in rapid standing assessments
  - Intelligent agent-based real-time cue processing & analysis
  - Temporal cue pattern identification
  - Embodied avatar effectiveness optimization
  - Repeated assessment analysis and baseline profiling
  - Effective threat index and deception index development

Embodied Avatar Kiosk

Rapid Deception Assessment Screening

Intelligent Agent (IA) Selects Interview

Embodied Avatar presents Question

Sensors Capture Subject Responses

Real-Time Response / Cue Analysis

IA Fuses Analyses, creates ranking

IA Selects Next Question

Done?

IA Generates Final Ranking and Analysis

Embodied Avatar Kiosk

Video Example