



# Avatar-Kiosk

Douglas C. Derrick

*University of Arizona*





# Research Problem

## Information quality and credibility

**Truth** vs. **Deception**





# The Problem

- People deceive
- Humans are poor lie detectors
  - Both novices and experts
- DHS personnel have to make rapid decisions about credibility (7 seconds)
- Cross border traffic is projected to continue to increase over the next two decades





# Types of Deception

- Lies
- Fabrications
- Concealments
- Omissions
- Misdirection
- Bluffs
- Fakery
- Mimicry
- Tall tales
- White lies
- Deflections
- Evasions
- Equivocation
- Exaggerations
- Camouflage
- Strategic ambiguity
- Hoaxes
- Charades
- Imposters



# Methods to Detect Deception

- Behavioral Cues
  - Linguistics
  - Vocalics
  - Kinesics
  - Proxemics
- Psychophysiological Cues
  - Heart rate
  - Eye behavior (saccade, pupil dilation, gaze duration)
  - Respiration rate
  - Body temperature

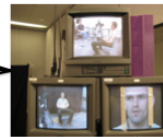


# Cues and Sensors for Deception Detection

## Psychophysiological & Behavioral Measures



Linguistics  
Vocalics  
Kinesics



Blood Pressure  
Heart Rate  
Respiration



Facial / Orbital  
Body Temperature



Blink Frequency  
Startle Response



Iris Identification  
Pupil Dilation



Gaze Behavior  
Object Recognition  
Pattern Classification

## Sensors

Video Cameras

Laser-Doppler  
Vibrometer

FLIR Thermal  
Camera

UltraFast Near  
Infrared

Pupillometric  
Near Infrared

Eye Tracker

DATA FUSION ENGINE



# Sample Deception Indicators

Arousal-based Cues	Emotion-based Cues	Memory Processes	Cognitive Effort	Communicator Tactics
higher pitch	higher pitch	brief messages	long response latencies/pauses	equivocal language
vocal tension	unpleasant voice	fewer sensory details	“ah” speech dysfluencies	nonimmediate language
“non-ah” speech dysfluencies	Negative affect terms	simpler language	simpler language	lower or higher involvement
Increased loudness	false smiles	less complex sentences	gaze avoidance	submissiveness
random trunk & limb movement	micromomentary facial fear or guilt	greater uncertainty	brief messages	brief or longer messages
self-focused touch	nervous laughter	fewer gestures	cessation of gesturing	postural rigidity/behavioral suppression





# Detection Cues

Text	Audio	Video
<ul style="list-style-type: none"><li>•More quantity</li><li>•More ellipses in text (pauses)</li><li>•Less possessive pronoun usage</li><li>•Less complexity</li><li>•Less diversity</li><li>•More non-immediacy</li><li>•More time communicating</li><li>•Simpler sentences</li><li>•Shorter sentences</li><li>•Less informality</li><li>•Less redundancy</li><li>•Fewer modal verbs</li><li>•Fewer modifiers</li><li>•More subjectivity</li><li>•More uncertainty</li></ul>	<ul style="list-style-type: none"><li>•Higher pitch</li><li>•More pitch variance</li><li>•Decreased intensity</li><li>•Increased response latency</li><li>•Increased subject turns</li><li>•Less fluency</li><li>•Increased overlap in speaking</li><li>•Less talk time</li><li>•Increased unfilled pause length</li></ul>	<ul style="list-style-type: none"><li>•Less change in head angle</li><li>•Less change in head position</li><li>•Less change in hand positions</li><li>•Less distance between the right and left hands</li><li>•Less distance between hands and the body</li><li>•Less amount of time hands are away from body</li></ul>







# The Guiding Premise

Cues leak out no matter how hard a person tries to conceal them





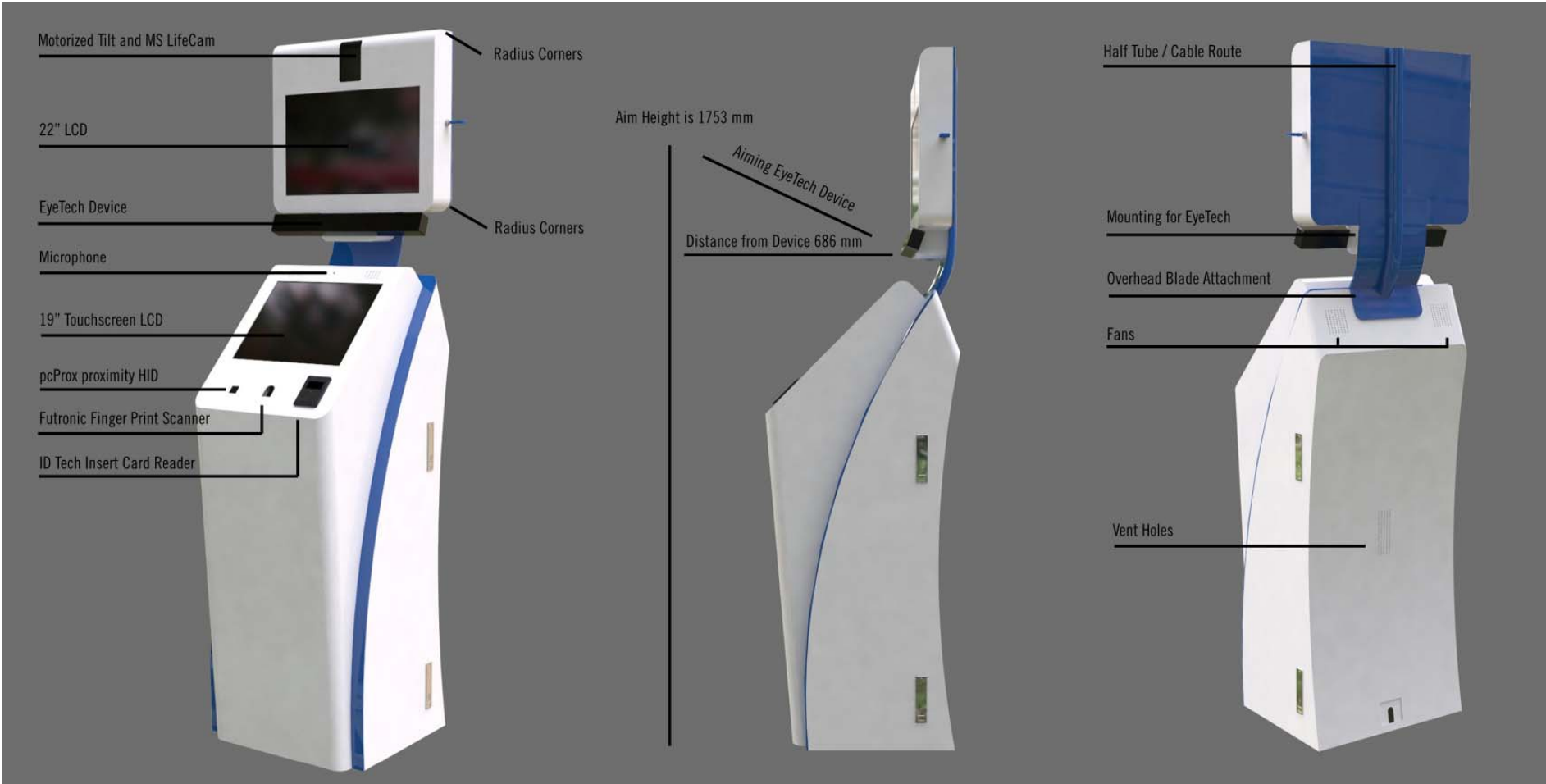
# Our Solution

- Automated kiosk
- Interactive intelligent agent
  - Embedded sensors
  - Avatar-based interviewer
  - Expert system





# Automated Kiosk



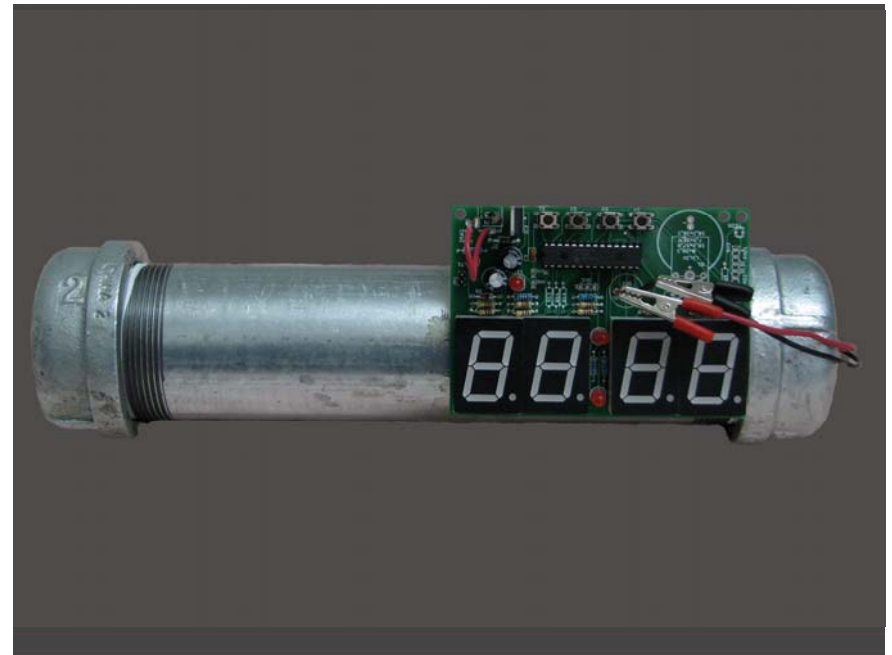
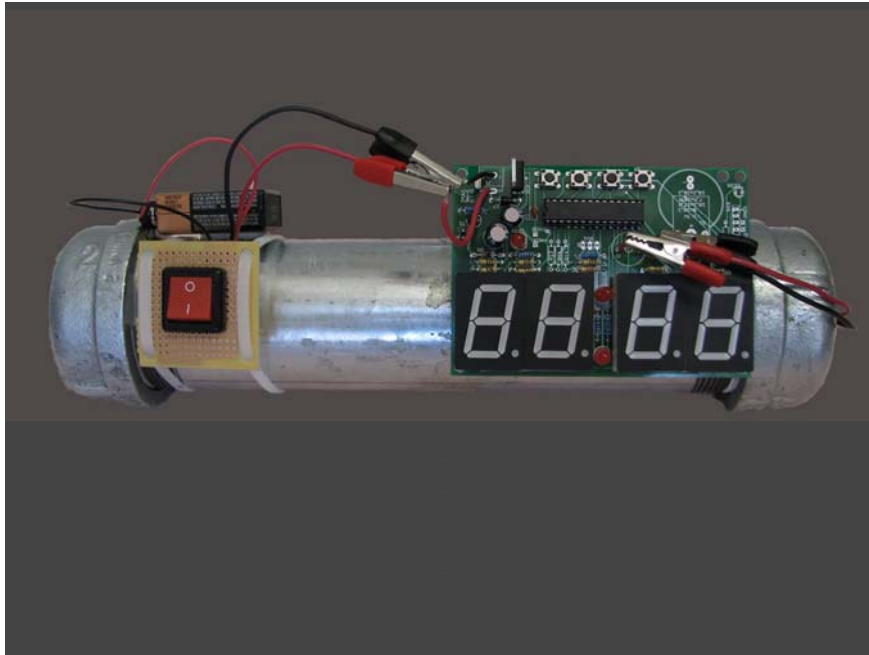


# Sample Avatars



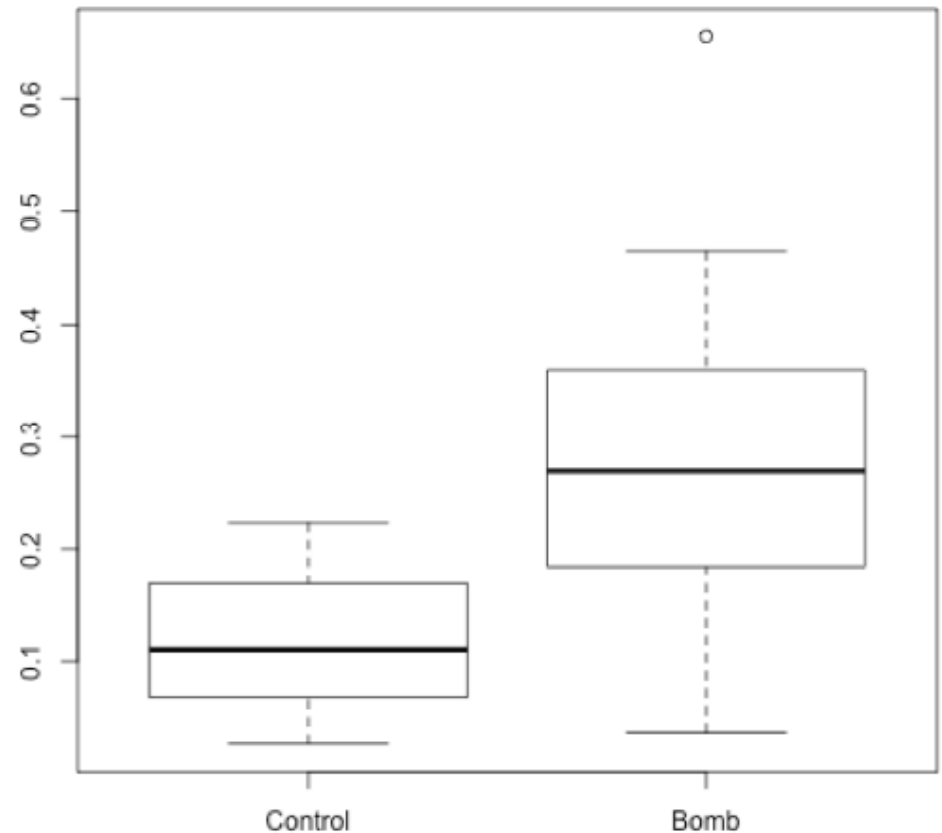


# Bomb Study



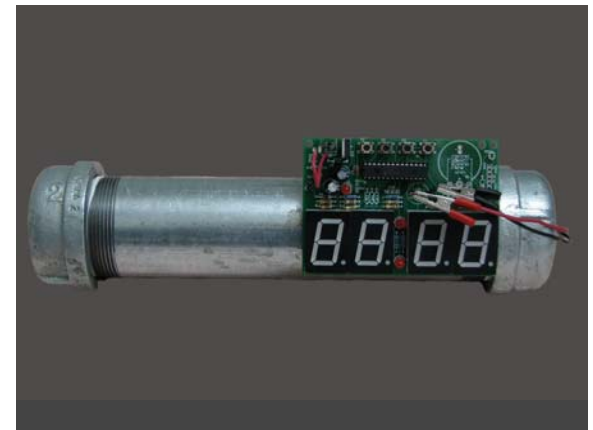
# Gaze Analysis

- Control
  - Average = 12.43%
- Bomb
  - Average = 28.52%



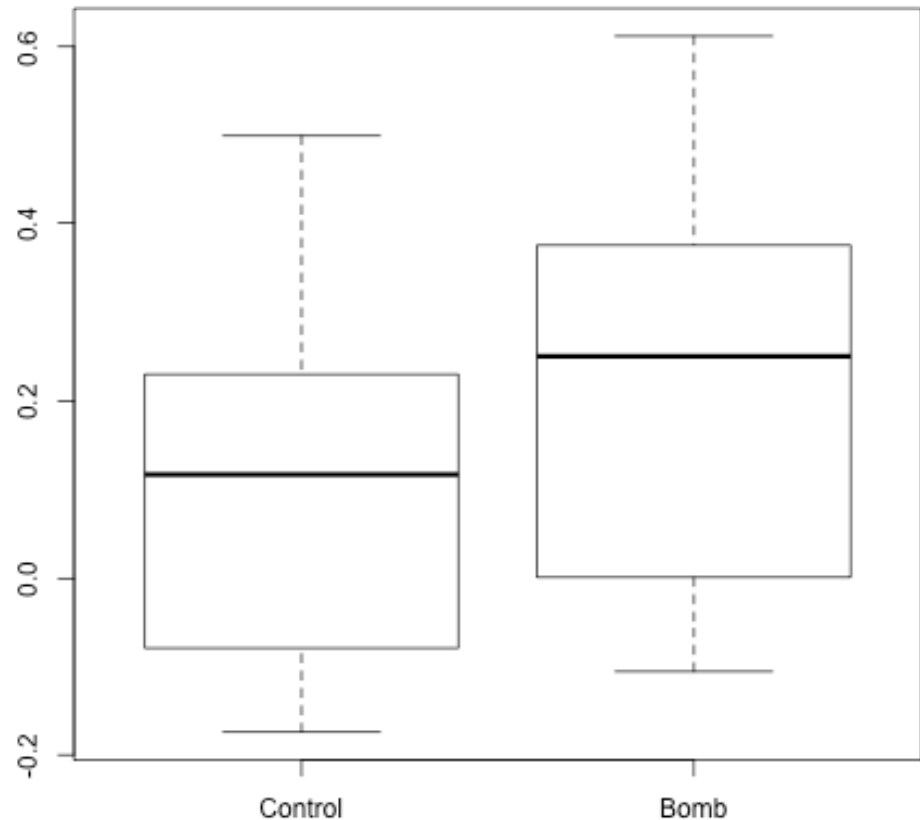
# Pupil Dilation Algorithm

- Participants shown three images
  - Car, bomb, keyboard
- Viewed each image for 12 seconds
- Eye sampled every ~30ms
  - 33-34 samples per second
- Captured pupil dilation (mm) for each eye for each sample
- Calculated the average pupil dilation for the image
- Compared the difference in pupil dilation between images 1 and 2



# Pupil Dilation Differences

- Control
  - Average = .1139 mm
- Bomb
  - Average = .2146 mm







# Classification Results

- To be innocent
  - Meet gaze behavior threshold (17%)
  - Meet dilation difference threshold (.28 mm)

	<b>BOMB</b>	<b>CONTROL</b>
<b>BOMB</b>	16	4
<b>CONTROL</b>	0	10

**87% Accuracy**





# Conclusion

- Early successes
- National and international excitement and support
  - Frontex workshop (Warsaw, Poland)
  - Amsterdam (Schiphol Airport)
  - DHS Port of Entry
- National visibility
  - National Geographic
  - Discovery Channel
  - USA Today

