National Center for Credibility Assessment Research & Development

NCCA Research // DOI-6
March 19, 2013

This briefing is classified

UNCLASSIFIED

DEFENSE INTELLIGENCE AGENCY

Insider Threat

DOI-6 // NCCA

A primary research effort at NCCA is the identification and neutralization of insider threat. NCCA is addressing this issue by:

- Identifying strengths and weaknesses of existing credibility assessment tools
- Enhancing current tools and methods
- Developing and validating new tools, techniques, and processes
- Exploiting/re-tooling existing technologies for integration into the IC mission
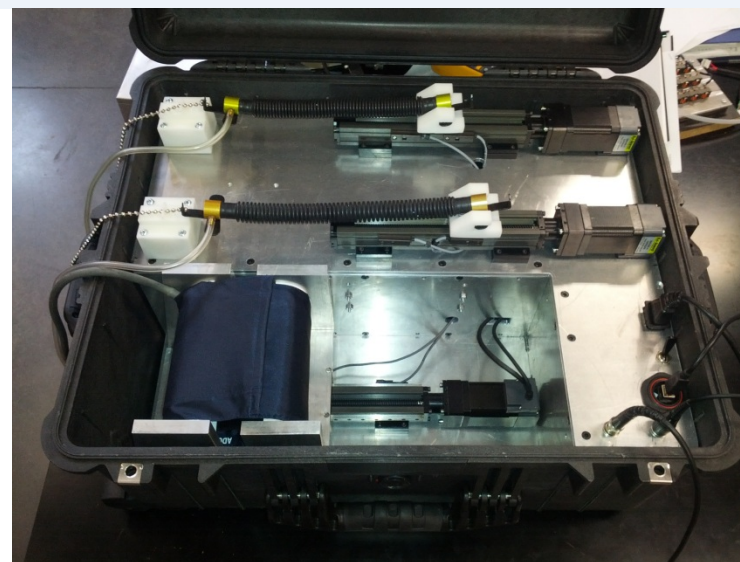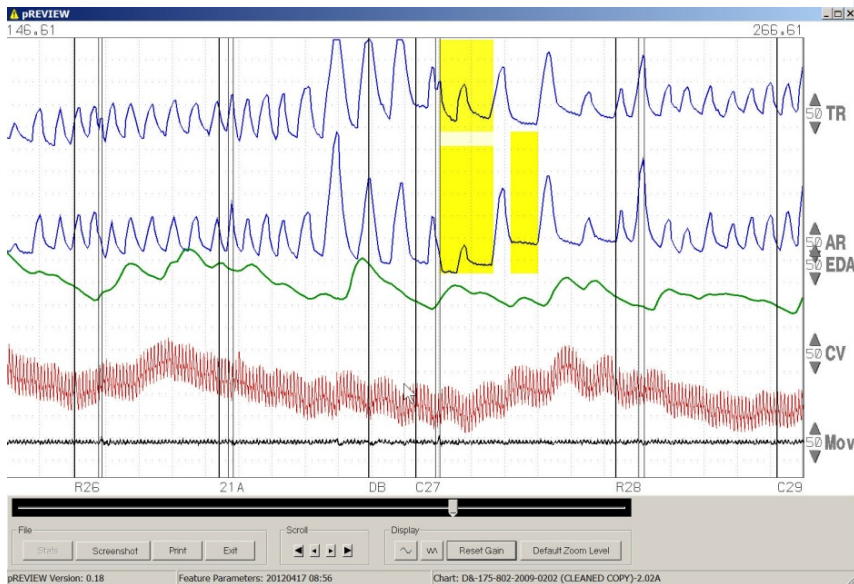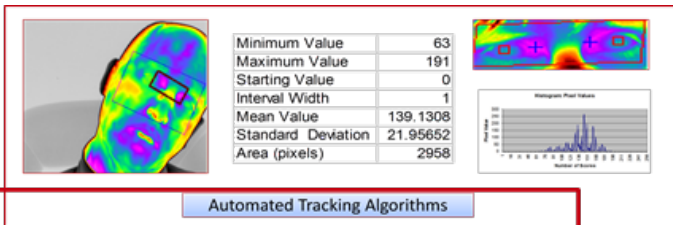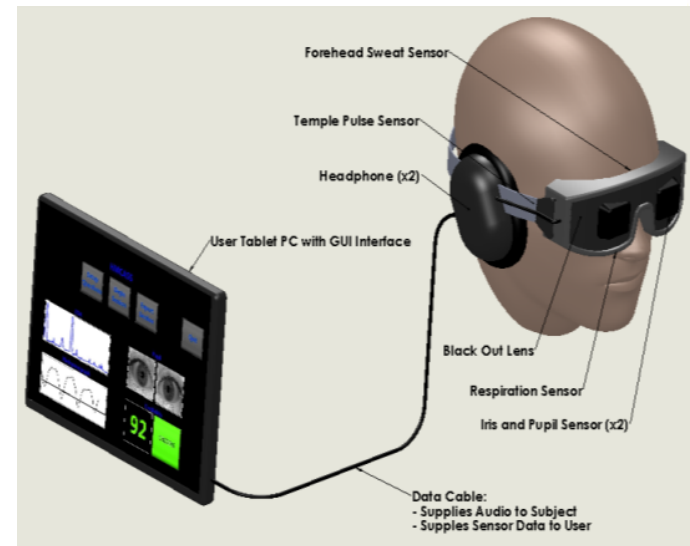
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Asset Validation

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A primary research effort at NCCA is to provide new technology to assist in asset validation. NCCA is addressing this issue by:

- Designing and evaluating sensors and collection platforms to determine the physiological state of individuals using overt or surreptitious capture to assist in evaluating the credibility of subjects.

- Evaluating the robustness of sensor technology in less structured environments such as interviews and casual conversations.

- Identifying the needs of the IC community to integrate new technology into appropriate asset validation environments.

Forehead Sweat Sensor
Temple Pulse Sensor
Headphone (x2)
User Tablet PC with GUI Interface
Black Out Lens
Respiration Sensor
Iris and Pupil Sensor (x2)
Data Cable:
- Supplies Audio to Subject
- Supplies Sensor Data to User

Minimum Value	63
Maximum Value	191
Starting Value	0
Interval Width	1
Mean Value	139.1308
Standard Deviation	21.95652
Area (pixels)	2958

Automated Tracking Algorithms

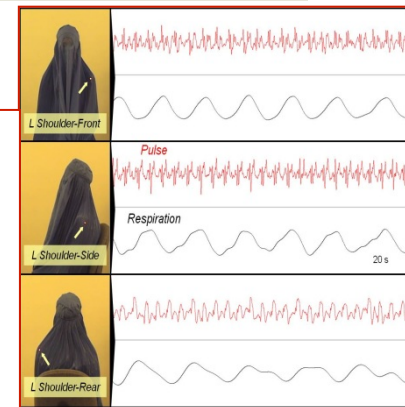Miniaturized Thermal Cameras

Long Range Physiology: Pulse and Respiration Signals Using Polytec Infrared Laser Doppler Vibrometer

Pulse
Respiration
20 s
Scene through laser lens
Polytec OAM-1000
Gross scene from window
Distance = 290 m

L Shoulder-Front
L Shoulder-Side
Pulse
Respiration
20 s
L Shoulder-Rear

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Project Descriptions

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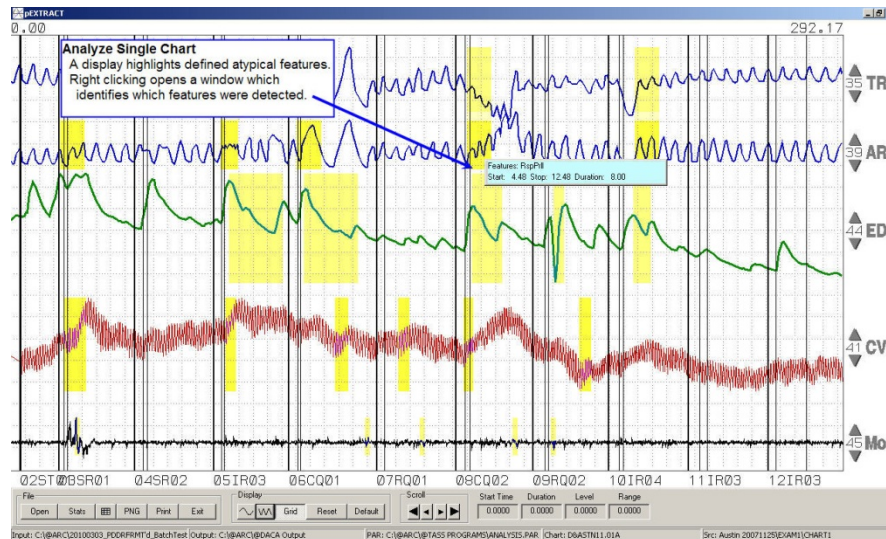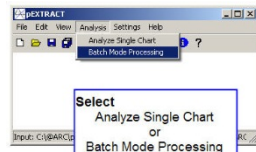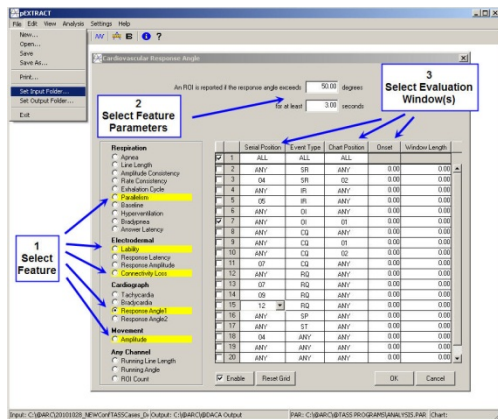
Atypical Response Detection and Identification

Purpose: Detect and identify countermeasure responses in polygraph charts – which will enhance the accuracy of physiological data analysis during exams.

Objective: Develop software to assist the polygraph examiner in detecting and identifying atypical and countermeasure responses.

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Atypical Response Detection and Identification

Objective & Associated Mission/Vision

Project Objectives:

•Validate the countermeasure detection features taught by the NCCA Threat Assessment and Strategic Support Branch.

•Field software to assist Polygraph Examiners in identifying countermeasures.

•Determine if there are additional countermeasure indices we are not aware of.

Mission/Vision: NCCA's primary function is training, continuing education, and support of Federal Polygraph examiners – the majority of whom are involved in CI screening of applicants and employees. This effort will validate training materials and directly support the field polygraph examiner decision process.

Activities

Recent Activities: Software has been developed to a) convert raw polygraph data from vendor proprietary formats to a common NCCA specification, b) extract currently taught countermeasure identifiers according to user specified parameters, and c) identify user specified countermeasure features in commercial software. Initial feature analysis does not support occurrence of unique countermeasure responses.

Near Term Plans: Feature specifications are being refined and additional data evaluated.

Funding

FY12: $99,200
FY13: $100,000
FY14: $100,000 (Projected)

Key Milestones

Overall Status: Ongoing Research and Development

Milestones	Deliverable	Date	Status
pREFORMAT version 1.00	Software	Dec 2011	
pEXTRACT version 0.63	Software	Jan 2012	
pREVIEW version 0.08	Software	Jan 2012	
Preliminary Field Test of pREVIEW	Software	Jun 2012	
Determine frequency of CM features	Interim Report	Jun 2012	
Refine feature parameters & algorithms	Software	Dec 2013	
Report & Software	Interim Delivery	TBD	

Summary & Expected Customer Benefits

Summary:

•NCCA will have objective empirical support for countermeasure detection during polygraph testing, as opposed to the "best practices" currently taught.

•Field polygraph examiners will have immediate validated feedback regarding atypical responses in the examination room.

•NCCA will have tools to objectively evaluate polygraph data for additional identifiers of countermeasures and deception.

Expected Customer Benefits: The Federal Polygraph examination process will be quantitatively improved resulting in a reduction of insider threat throughout the intelligence community.

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Physiology Simulator for Polygraph System Testing and Validation

Circuit Board Fabrication
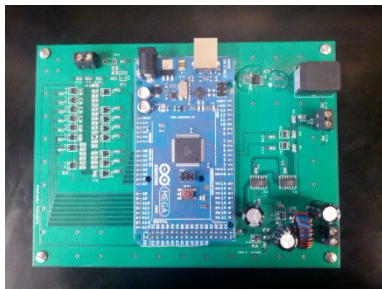
Concept Testing
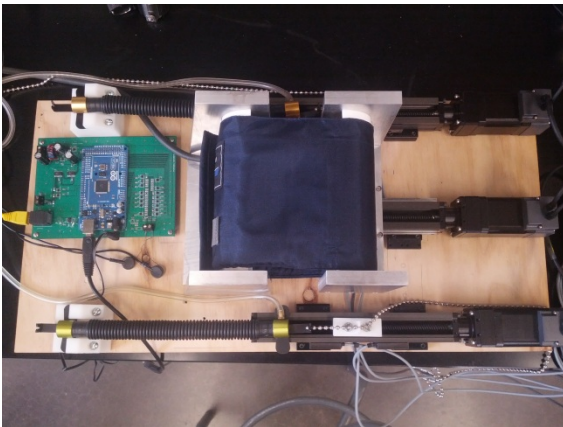
Multi-Channel Physiological Simulator (Deliverable)

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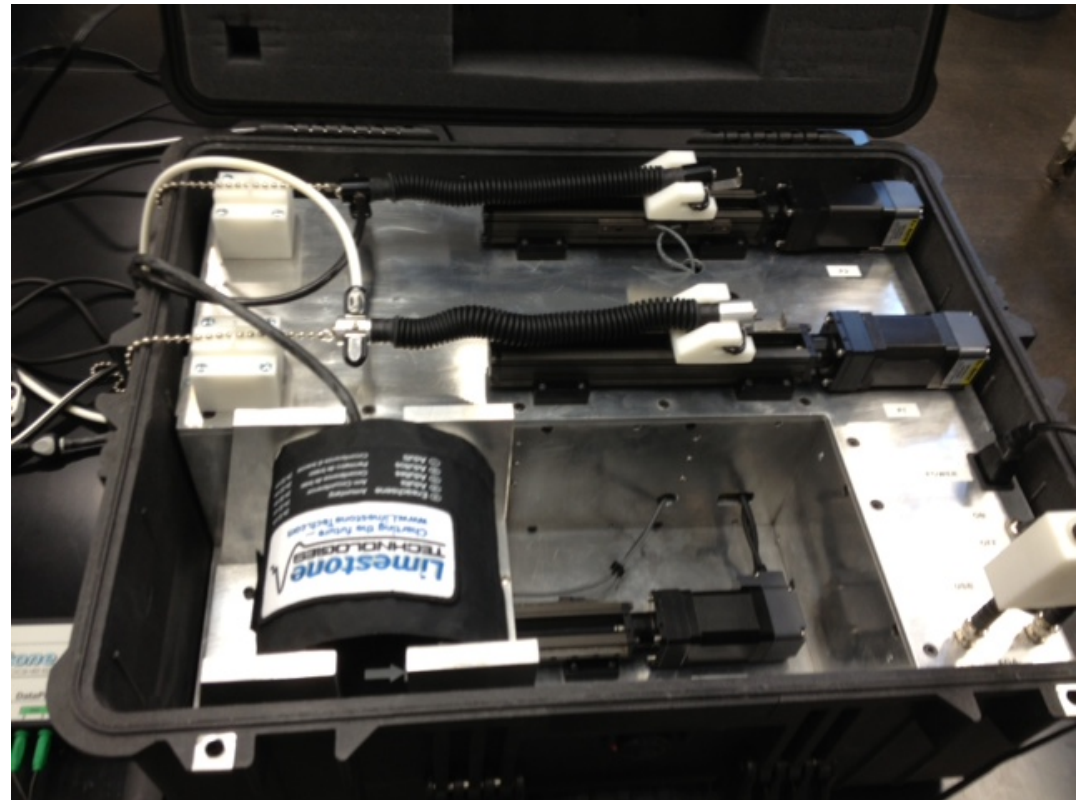
Physiology Simulator for Polygraph System Testing and Validation

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Objective & Associated Mission/Vision

Project Objective: This project was undertaken to develop hardware and software to evaluate the specifications and limitations of commercial polygraph systems. The long-term goals are to develop a system that can be used to periodically calibrate polygraph instruments in use by Federal polygraph examiners and to ensure consistency among polygraph instruments.

Mission/Vision : This effort was undertaken to assist the Federal Polygraph Community by creating standards for polygraph instrumentation and providing a method to evaluate instrument accuracy. This will assist the entire Intelligence Community by ensuring more accurate and reliable polygraph testing.

Activities

Recent Activities: A physiological simulator for polygraph system testing has been developed and delivered to NCCA. A NCCA scientist is now evaluating the simulator performance and developing signals to be used for evaluation and calibration of polygraph instruments.

Near Term Plans: The simulator will be used to examine the quality of signals output by polygraph instruments given a consistent known input signal. The consistency will be reported, as well as any anomalies encountered. Work towards developing signals which can be used to calibrate field instruments in the field is proceeding.

Funding

FY12: $0
FY13: $50,000
FY14: $50,000 (Projected)

Key Milestones

Overall Status: Ongoing Research and Development

| Milestones	Deliverable	Date	Status
Initial discussions with NSF CITeR	Proposal	March 2010	
Project funded via NSF's CITeR	None	Jul 2011	
Kickoff Meeting	Site Visit	May 2012	
Interim Meeting & Simulator Mock-up	Site Visit	Aug 2012	
Received Simulator	Site Visit	Nov 2012	
Additional simulators negotiated	Contracting	Jan 2013	
System Delivery	Awaiting Funding	Sept 2013	

Summary & Expected Customer Benefits

Summary:
• Similarities and differences among commercial polygraph instruments can be evaluated.
• Filter and amplification characteristics of commercial polygraph can be determined.
• Scientists and polygraph examiners will be able to see the influence of different software settings on the evaluated signals.

Expected Customer Benefits: NCCA will be able to evaluate the impact of differences between polygraph systems and provide guidance and recommendations to the Federal Polygraph Community. This should result in more consistent data recording, increased decision accuracy, and reduce inconclusive decision rates. This will have a positive impact on government screening, employee satisfaction, and the federal budget.

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Automated CI Screening System

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Opening Statements → Irrelevant Questions → Mental Health Questions

"Yes" Response To First Alcohol Use Question ← Alcohol Use Questions → "No" Response To First Alcohol Use Question

Follow-on Alcohol Use Questions

"Yes" Response To First Drug Use Question ← Drug Use Questions → "No" Response To First Drug Use Question

Follow-on Drug Use Questions

"Yes" Response To First Crime Question ← Crime Questions → "No" Response To First Crime Question

Follow-on Crime Questions → Comparison Questions → Closing Statements

Relevant Admissions by Category

Number of Participants

Paper and Pencil
CG Interview

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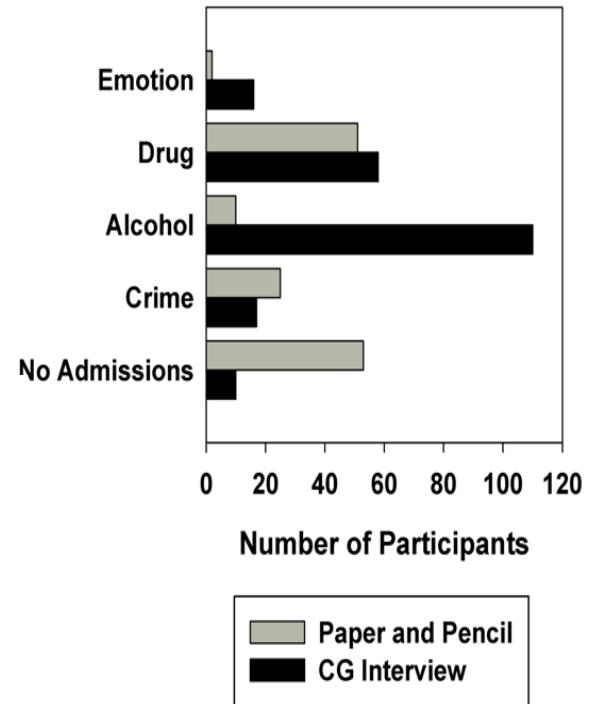
Automated CI Screening (AVATAR)

Objective & Associated Mission/Vision

Project Objective: This effort will standardize, enhance accuracy, and improve the utility of the counterintelligence screening process. Using computer-generated (CG) agents and automated interviews, we are developing standardized tests that can elicit accurate information and reduce biases during the credibility assessment process.

Mission/Vision : NCCA has been working to develop new credibility assessment tests and new test formats for many years. The challenge is to mitigate gender, cultural, and personal biases & social constraints when humans conduct credibility assessment interviews. We also believe that these computerized tests, when used in combination with traditional polygraph techniques, will increase the effectiveness of the current CI screening process.

Activities

Recent Activities: Collaborations with the Office of the Director of National Intelligence and FBI have resulted in the development of a preliminary CG pre-employment screening interview that preliminary tests indicate is effective. Industry and academic partners including Battelle Memorial Institute, Washington University in Saint Louis, and West Virginia University have also been working with the new system and we have shown that standardizing interview processes with CG agents permits elucidation of relatively complex response patterns, including behavioral changes in response to specific types of questions during deception.

Near Term Plans: Completion of a new prototype, as well as an independent laboratory study utilizing human subjects will be conducted to validate the system and optimize decision algorithms.

Funding

FY12: $461,422 FY13: $400,000   FY14: $250,000 (Projected)

Key Milestones

Overall Status: Ongoing Research and Development

Milestones	Deliverable	Date	Status
Preliminary Laboratory Study	Data	Jan 2011	
Laboratory Study II	Data	April 2011	
Preliminary Laboratory Study	Manuscript	Dec 2012	
Laboratory Study II	Manuscript	Dec 2012	
System Prototype I	Preliminary Prototype	June 2012	
System Prototype II	Final Prototype	Oct 2013	
Field Testing	Data	Jun 2014	

Summary & Expected Customer Benefits

Summary:
•A computerized credibility assessment system.
•Validation studies.
•Improved classification accuracy with reduction in inconclusive rate.
•New standardized CI Interview for use prior to polygraph.
•New credibility assessment algorithms.
•Government-owned code.
•Improved CI screening process.

Expected Customer Benefits: Improved CI screening process will reduce the need for repeated polygraph testing (bring backs) to resolve issues. A wealth of new data using a new process will allow for the development of new screening algorithms.

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Physiological Programming Interface

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Face shape:
- Neutral
- Blends set to 0.0

Body / Clothing:
- Oxford

Textures:
- Face Texture: Male 7.dds
- Face Normal: Default.Normal.png
- Eyes: Brown 01.dds
- Mouth: Teeth 03.dds
- Body: Oxford.dds

Camera Position: (X,Y,Z) = (0, 2, 15) (Default)
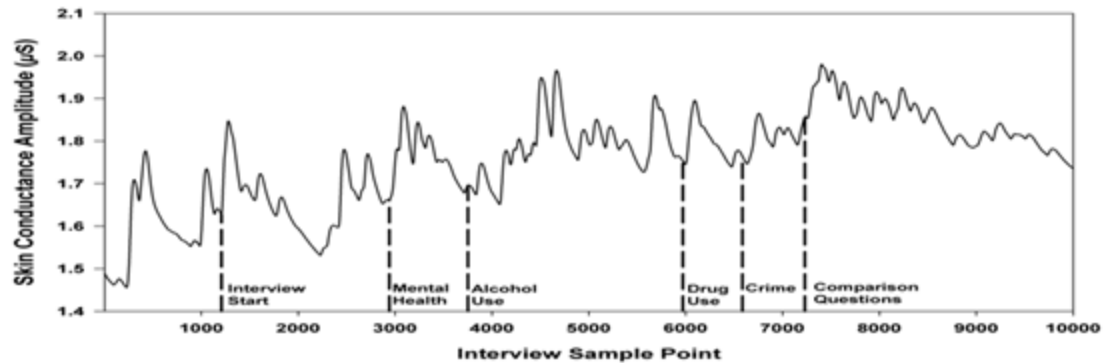
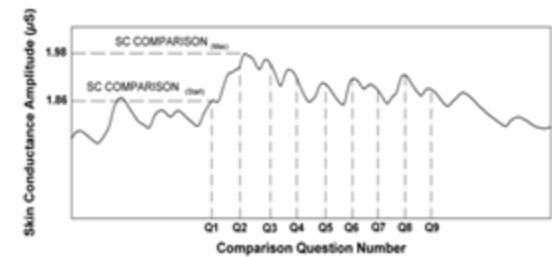Light Direction: (X,Y,Z) = (0.44, -0.22, -0.87)

Animation parameters:
- CurveScale = 100 (Default)
- SlopeScale = 100 (Default)

Voice:
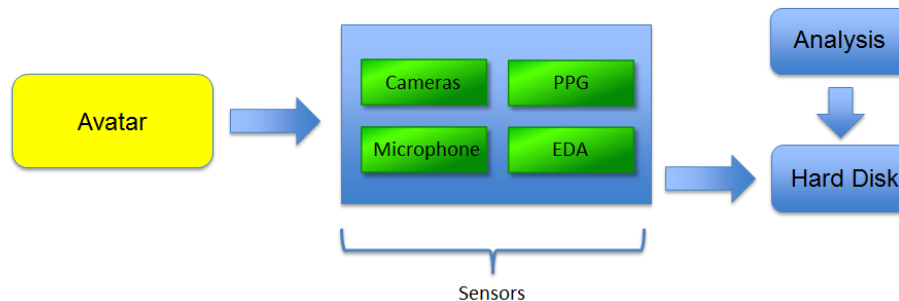- VW Paul
- Pitch = 0 (Default)
- Rate = 0 (Default)

SC ALCOHOL (Amplitude) = SC ALCOHOL (Max) - SC ALCOHOL (Start) = 1.97 μS - 1.70 μS = .27 μS

SC COMPARISON (Amplitude) = SC COMPARISON (Max) - SC COMPARISON (Start) = 1.98 μS - 1.86 μS = .12 μS

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Integrating Physiological Programming Interface with Avatars

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Objective & Associated Mission/Vision

Project Objective: This effort will extend the capabilities of an existing Avatar system, by designing a method to capture the physiological state of the subject during the course of the interview using a sensor measuring electrodermal activity (EDA), a photoplethysmographic (PPG) sensor and two thermal imaging cameras that operate in the long-wave infrared (LWIR) band, i.e., 7.5-13.5μm, as well as a new programming interface for use with 3rd party hardware.

Mission/Vision : Our approach integrates physiological measurements and audio recordings to enhance the credibility assessment capabilities of a state-of-the-art Avatar system.

Activities

Recent Activities: By designing a software tool for data acquisition, storage and retrieval, the integration process is done in a systematic manner. Our system is comprised of four sensors, which are used to measure the physiological state of the subject. Two LWIR thermal imaging cameras provided by FLIR Inc. are placed on either side of the subject and monitor temperature fluctuations of the face of a subject under interview.

Near Term Plans: Synchronize the recorded audio responses to the avatar's generated questions with physiological measurements of the subject, thereby facilitating a broader range of analysis that is expected to enhance the capabilities of current approaches towards effective deception detection..

Funding

FY12: $190,000
FY13: $42,628
FY14: $100,000 (Projected)

Key Milestones

Overall Status: Ongoing Research and Development

Milestones	Deliverable	Date	Status
Hardware Integration	Hardware	Aug 2012	
Software Integration	Software	Dec 2012	
CITeR Proposal Approval	CITeR Funding	Jan 2013	
Data Analysis Program Development	Software	July 2013	
System Prototype I	Preliminary Prototype	July 2013	
Laboratory Testing	Manuscript	Dec 2013	
Algorithm Development	Algorithms	Jun 2014	

Summary & Expected Customer Benefits

Summary:
•A physiological data collection and analysis system.
•Integration with automated (AVATAR) interview.
•A physiological data analysis program.
•Laboratory test of the hardware, software, and interface.
•New credibility assessment algorithms.
•Government-owned code.
•Improved credibility assessment.

Expected Customer Benefits: Improved credibility assessment process will reduce the need for repeated polygraph testing (bring backs) to resolve issues. A wealth of new data using a new process will allow for the development of new screening algorithms.

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IR LDV System

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Long Range Infrared Laser Biometrics

Distance ~ 290 m

through laser lens

pulse

LDV System with new FLIR and Point Grey Cameras

FireWire 800 — Laser Coaxial Camera — Point Grey Camera

USB 3 Hub — 4 Channel Microphone Array — Kinect

Velocity — Microphone (sync'd to Velocity)

Level

Aux1 — High Quality Microphone — FLIR Thermal Camera

Aux2

Ethernet

Power

External Microphone Input

Long Range Physiology: Pulse and Respiration Signals Using Polytec Infrared Laser Doppler Vibrometer

Pulse

Respiration

20 s

Scene through laser lens

Polytec OAM-1000

Gross scene from window

Distance = 290 m

Alternative Target Sites

L Shoulder-Front

Pulse

Respiration

20 s

L Shoulder-Side

L Shoulder-Rear

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Infrared Laser Doppler Vibrometry System (IR-LDV)

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Objective & Associated Mission/Vision

Project Objective: This effort will enhance development of the existing NCCA IR LDV system. The effort moves the existing breadboard system into a BETA system phase with continued algorithm development for enhancing the real-time capabilities and decision-making capabilities of the IR LDV system for credibility assessment (CA).

Mission/Vision : NCCA has been involved in the development of the LDV system for credibility assessment and biometric capabilities since inception. Emerging laser technologies have now allowed for the development of the LDV system utilizing an infrared laser. This capability provides complete eye safety and better signal acquisition as well as clandestine capabilities.

Activities

Recent Activities: On-going laboratory testing and preliminary analyses are being conducted; Integration of Kinect-based system for enhanced tracking and targeting capabilities; continued analyses of the NCCA CARI-II LDV database; development of more accurate analysis algorithms.

Near Term Plans: Full integration of Kinect-based targeting/tracking system and system tests; near real time system decision output; integration of a small thermal camera into the system for additional data capture; NCCA Research is developing plans for a field validation test proposed to occur in FY13.

Funding

FY12: $400,000
FY13: $150,000
FY14: $200,000 (Projected)

Key Milestones

Overall Status: Ongoing Research and Development

Milestones	Deliverable	Date	Status
Computerized feature extraction	Software	Sept 2012	🟩
Began data collection	Site Visit	Sept 2012	🟩
Interim Data collection	Site Visit	Jan 2013	🟨
Completed data collection	Site Visit	May 2013	🟨
Complete data analysis	Summary	Aug 2013	🟨
Submit final report	Final report	Sept 2013	🟨
System Delivery	IR LDV system	Sept 2013	🟨

Summary & Expected Customer Benefits

Summary:
• Data can be obtained in realistic operational scenarios.
•Signal acquisition involves minimal or no operator involvement.
•Infrared laser mode of operation has been tested in upgraded unit with excellent target acquisition and signal quality.
•Significant improvements implemented in real-time analysis/interpretation.
•Implementation of biometric capabilities in testing phase with exceptional accuracy rates obtained from the individually unique LDV signal.
•Can be developed into small, lightweight, portable unit with telemetry of signals to remote operator for higher-level evaluation.

Expected Customer Benefits: The NCCA IR LDV collects physiological data via non-contact sensors. This data may be useful in determining credibility either from cooperative persons or surreptitiously. The additional potential capability of biometric identification makes the system a very useful tool throughout the Enterprise.

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OCASS System

Derived from: Multiple Sources
Declassify on: YYYYMMDD

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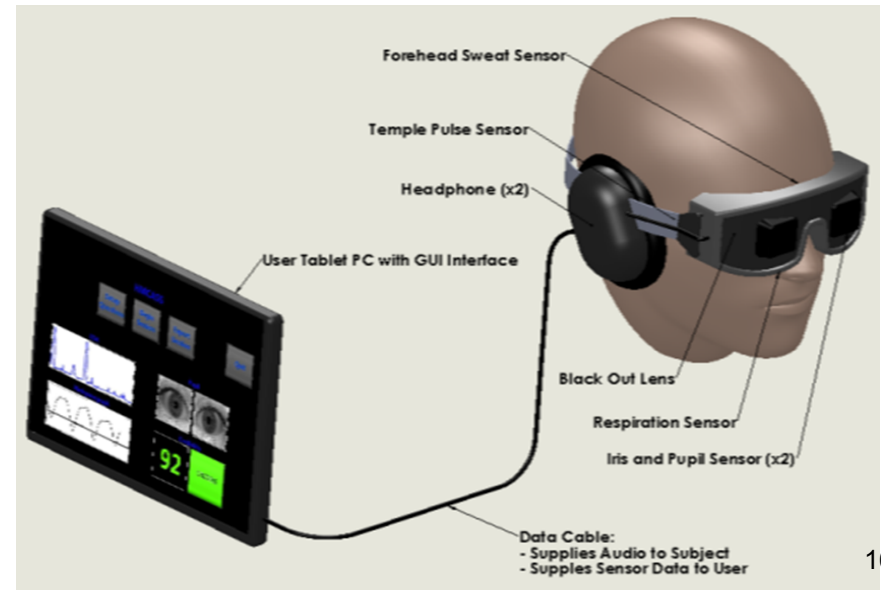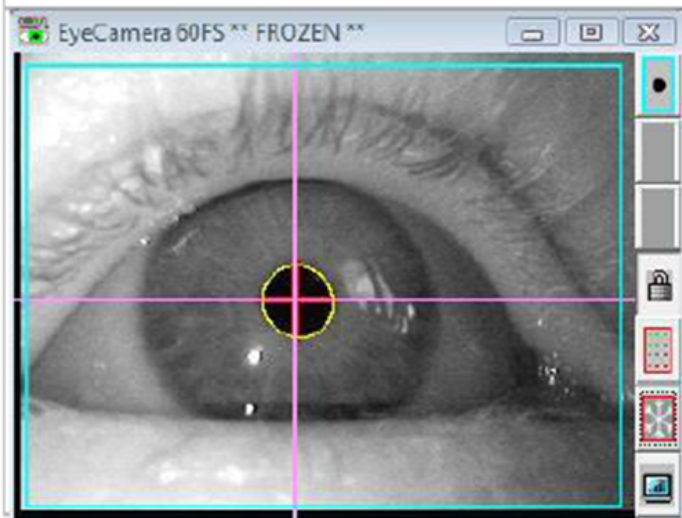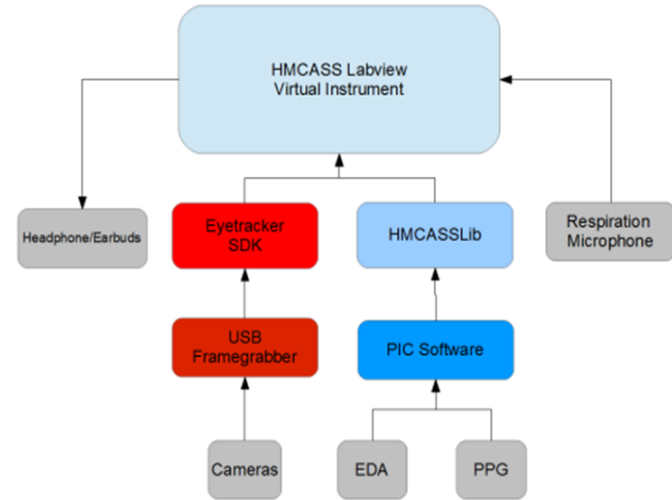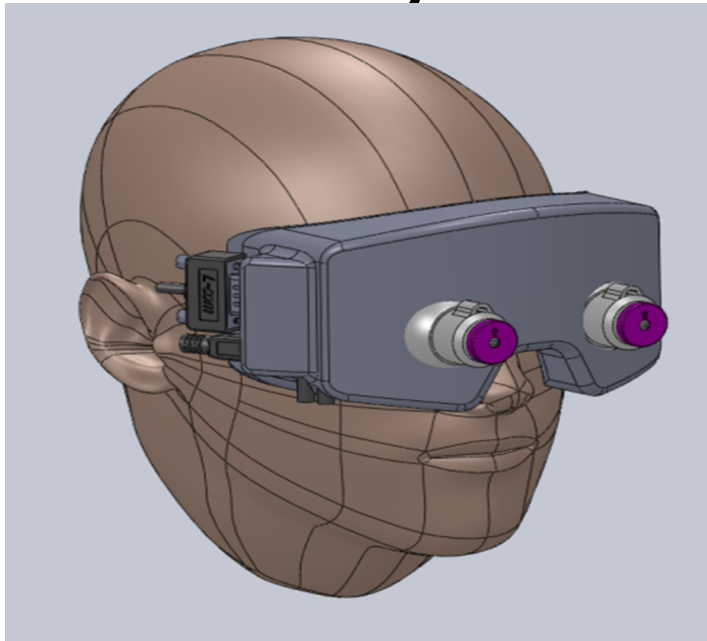
Ocular-Based Credibility Assessment Screening System (OCASS)

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Objective & Associated Mission/Vision

Project Objective: This effort will enhance the existing PCASS system. The new system will use new physiological measures, improved sensors, and automation to deliver more standardization, better accuracy, and less inconclusives. Referred to as the Ocular-based Credibility Assessment Screening System (OCASS), it will incorporate pupillary response, electro dermal, cardio signatures, and provide the questions in the native language of the subject.

Mission/Vision : NCCA has been involved in the development of advanced credibility assessment systems since inception. Emerging technologies have now allowed for the development of the OCASS system utilizing pupillometry. This capability provides complete eye safety, iris capture for biometrics, better signal acquisition, and improved classification accuracy.

Activities

Recent Activities: A preliminary laboratory study utilizing human subjects was recently completed to verify the best sites on the head to acquire electro dermal and vascular signatures. Utilizing these findings, the OCASS prototype system was designed and is currently being developed. The software, data acquisition system, and graphical user interface are near completion. The integration of the sensors into the goggle system is currently underway. A rugged tablet will be used as the processing unit

Near Term Plans: After completion of the prototype, two independent laboratory studies utilizing human subjects will be conducted to validate the system and optimize the decision algorithm.

Funding

FY12: $300,000
FY13: $500,000
FY14: $195,000 (Projected)

Key Milestones

Overall Status: Ongoing Research and Development

Milestones	Deliverable	Date	Status
Preliminary Laboratory Study	Data	Sept 2012	
Preliminary design review	Site Visit	Dec 2012	
Prototype development	Prototype	May 2013	
First Laboratory Study	Data	June 2013	
Algorithm Development	Algorithm	July 2013	
Second Laboratory Study	Data	Sept 2013	
System Delivery	Final Prototype	Nov 2013	

Summary & Expected Customer Benefits

Summary:
• A ruggedized OCASS system ready for field use with minimal operator training required..
• Signal acquisition involves minimal or no operator involvement.
• Improved classification accuracy with reduction in inconclusive rate.
• Simultaneous iris capture for biometrics.
• Automated question format introduced to each subject in their native language.
• Government-owned code.
• Lightweight, portable, and designed for ease of use.

Expected Customer Benefits: The NCCA OCASS collects physiological data via a customized goggle system. This data may be useful in determining credibility either from cooperative persons. The additional potential capability of biometric identification makes the system a very useful tool throughout the Enterprise.

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