MED-ENG®

A BRAND OF THE SAFARILAND GROUP

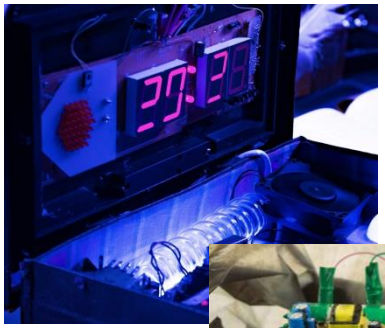
ENHANCED SITUATIONAL AWARENESS FOR THE MODERN EOD WARRIOR

ARIS MAKRIS, PH.D., V-P RD&E, CHIEF TECHNOLOGY OFFICER

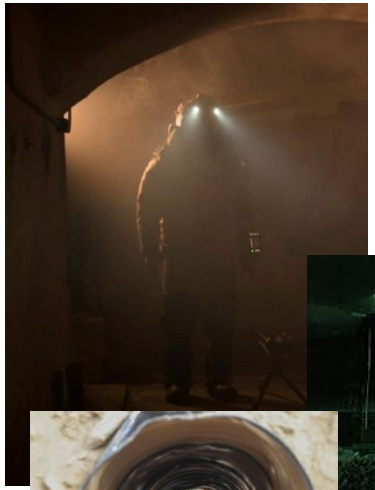
2021 FUTURE FORCE CAPABILITIES CONFERENCE AND EXHIBITION – OCTOBER 19, 2021

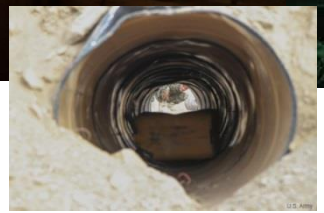
MORE COMPLEX ENVIRONMENTS FOR IEDD

Increasingly sophisticated IEDs



Operations in the dark / culverts





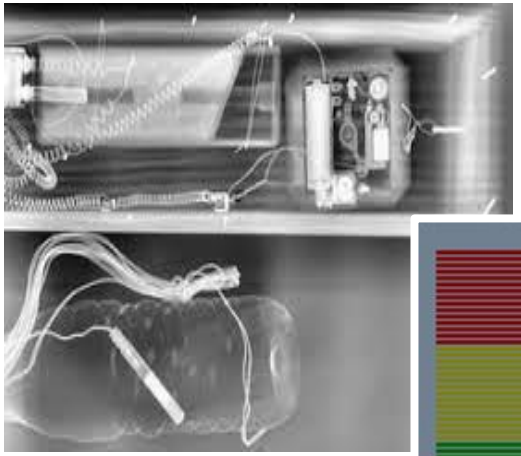
Non-permissive & Asymmetric Warfare

CBRN Contamination

NEED FOR ENHANCED SITUATIONAL AWARENESS

Operations in tunnels & low-light environments

Night warfare/ IEDD in the dark



Access to Real-Time Data, IED x-ray, intel

SITUATIONAL AWARENESS FOR EOD TEAM

- Ever-increasing need to enhance situational awareness
- Access to information & intel in real-time
- Share information with command post & other EOD assets
- Enable operations in all environments
- Integral element of bomb tech safety and effectiveness

Live Video / Camcorder

Radio comms

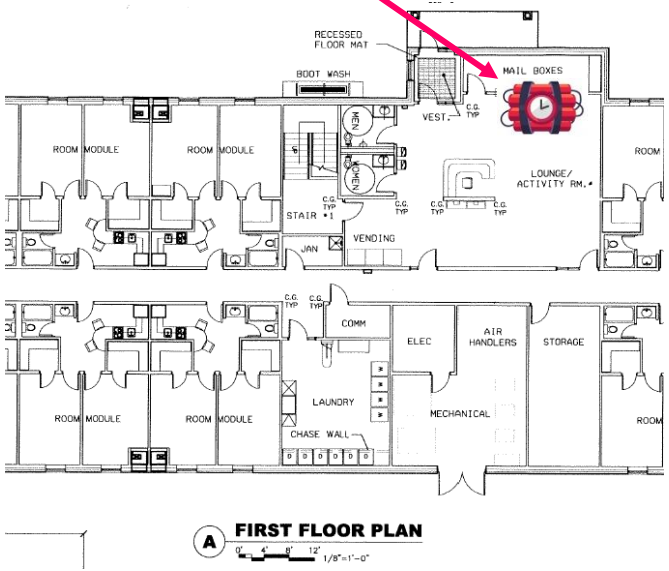
Various cameras
- *Visible*
- *Low Light*
- *Thermal...*

MAPS, FLOOR PLANS USEFUL FOR RSP, PLANNING

Enemy location

Escape route

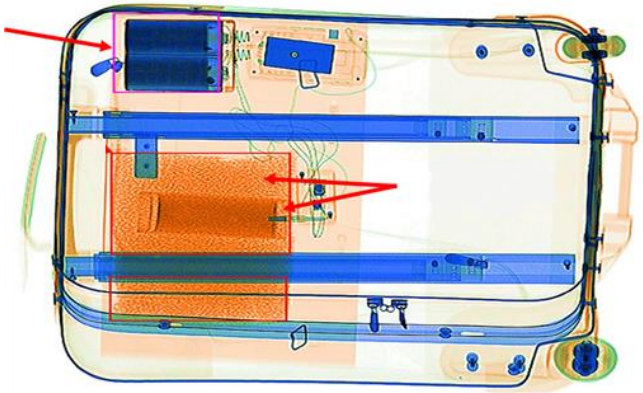
Threat Location

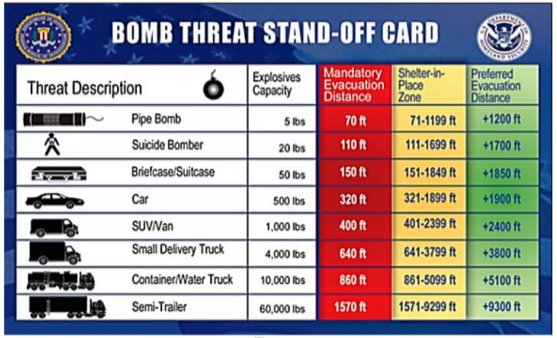


INFO ON EXPLOSIVE DEVICES, CHARTS, DATA

Access to render safe procedures that apply to current circumstances

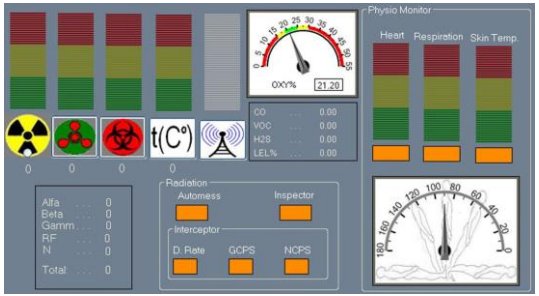
Access to x-rays on device or similar devices





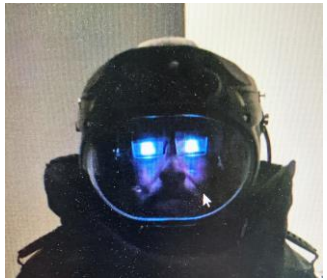
Threat Description	Explosives Capacity	Mandatory Evacuation Distance	Shelter-in-Place Zone	Preferred Evacuation Distance
Pipe Bomb	5 lbs	70 ft	71-1199 ft	+1200 ft
Suicide Bomber	20 lbs	110 ft	111-1699 ft	+1700 ft
Briefcase/Suitcase	50 lbs	150 ft	151-1849 ft	+1850 ft
Car	500 lbs	320 ft	321-1899 ft	+1900 ft
SUV/Van	1,000 lbs	400 ft	401-2399 ft	+2400 ft
Small Delivery Truck	4,000 lbs	640 ft	641-3799 ft	+3800 ft
Container/Water Truck	10,000 lbs	860 ft	861-5099 ft	+5100 ft
Semi-Trailer	60,000 lbs	1570 ft	1571-9299 ft	+9300 ft

Reference to explosive threat data, charts, intel



NEED FOR SAFE/SECURE COMMUNICATION

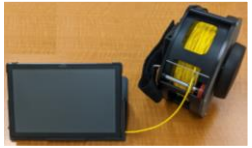
Operator



Drone

Command Post

ROV
- Sensors
- Video



Audio

Visual

Wireless

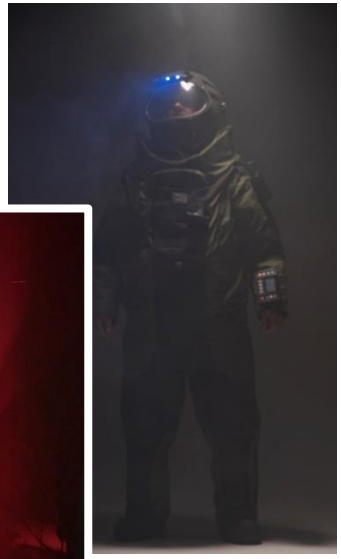
Wired

EOD OPERATIONS WITH LIGHTING OPTIONS

White LEDs

Red LEDs

Blue LEDs



- Must maintain situational awareness throughout
- Minimize chances of triggering light-sensitive IEDs
- Permit for local low lighting
- Reduce detection from afar

SOLDIER ENHANCED NIGHT VISION ENVG-B – L3 HARRIS

BINOCULAR GOGGLE

- White phosphor tubes and thermal imaging for dismounted soldier
- Mil Spec goggles for combat helmet

Key Features:

- Fusion technology
- Augmented technology
- Rapid target acquisition

SENSOR FUSION –VISIBLE, LOW LIGHT, THERMAL

Object edges from raw image (image segmentation algorithm)

All colors here are from thermal data

Real-time fusion of thermal camera and daylight camera data

Source: Liteye & ISTEC ICE Sign

INTEGRATED VISUAL AUGMENTATION SYSTEM (IVAS)

Provide Infantry with mixed reality headset:

- Night vision
- Thermal and day optics
- Map overlays
- Weapon sights
- Training

U.S.ARMY

Uses Microsoft Hololens technology

- Developed in 2016
- High resolution widescreen
- Head mounted display
- Accelerometer, gyroscope, magnetometer

SIGNIFICANT ADVANCES IN TECHNOLOGY FOR WARFIGHTERS & SPECIAL OPS TEAMS

Provide Infantry with mixed reality headset:

- N
- T
- N
- V
- T

U

- D
- 2.3-megapixel widescreen
- Head mounted display
- Accelerometer, gyroscope, magnetometer

What about EOD!

- EOD is not primary focus of technology for most defense companies (small market size)
- EOD is often lagging in adopting technological advances
- Enhance Situational Awareness through visual display(s) of EOD technician – Augmented Reality (AR)

NEED FOR INTEGRATED DISPLAY IN EOD HELMET

Communicate sensor outputs (visual, video, data readings)

In real-time

Enable more informed decisions

While minimizing distraction

Maximizing safety

Need integration into EOD Helmet

SOLUTION: HEADS-UP DISPLAY (HUD)

Heads-Up Displays

Transparent

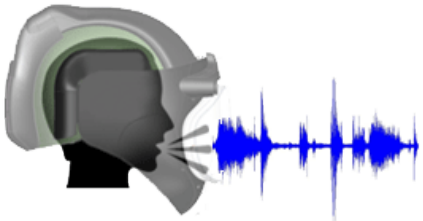
Opaque

Single-Eye

Dual-Eye

REQUIREMENTS FOR EOD:

- Image projection to an embedded HUD
  - Fit within tight space beneath EOD visor
  - Avoid ergonomic & mission interference
  - Customize technology to unique constraints
- Navigate display options / Select images:
  - Visible menus & controls
  - Voice commands
  - Audible alarms

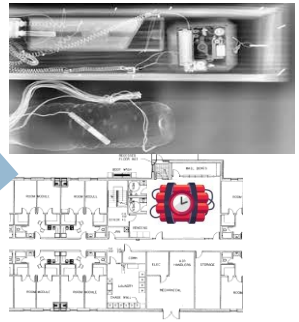


DATA CONVERGENCE TO HEADS-UP DISPLAY

CBRN sensors

Physiological Monitoring

Plug & Play



X-rays, plans

Bomb Suit status

Multi-Spectral Image sources

Blast sensor

EOD SPECIFIC PROGRAMS SINCE 9/11

For enhanced situational awareness

CRTI
Sensor Fusion
2007-09

CBRN Research and Technology Initiative

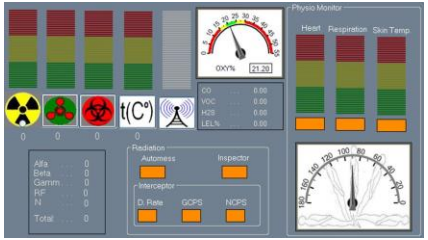
CTTSO/IWTSD
Bomb Suit HUD
2017-22

US Army
Next-Generation
Advanced Bomb Suit
2019-22

NGABS

CRTI – SENSOR FUSION FOR EOD RESPONDER

CBRNe Research & Technology Initiative 2007-09



IWTSD BOMB SUIT “HELMET MOUNTED” HUD

Distribution Statement A. Approved for public release. Distribution is unlimited

Requirements derived from evolving requirements of Military and Law Enforcement EOD

CA

LU

Dual-eye transparent HUDs

IWTSD HUD SENSORS – INTEGRATED ON HELMET

Distribution Statement A. Approved for public release. Distribution is unlimited

Multi-Spectral Camera
(Visible + Low light)

IR Illuminator

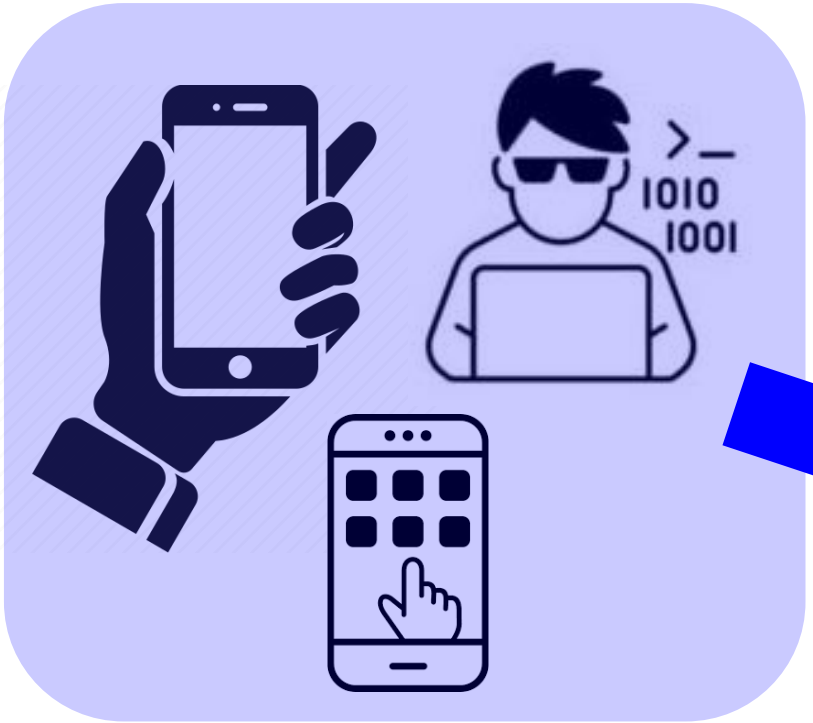
LWIR (Thermal) Camera

White LEDs

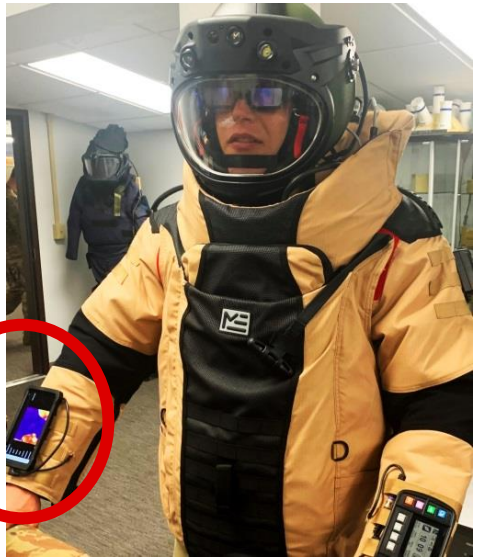
Displays:

- Camera images
- Sensor data
- Bomb suit status
- Smart Phone Images

LEVERAGE APP AND SMARTPHONE TECHNOLOGY

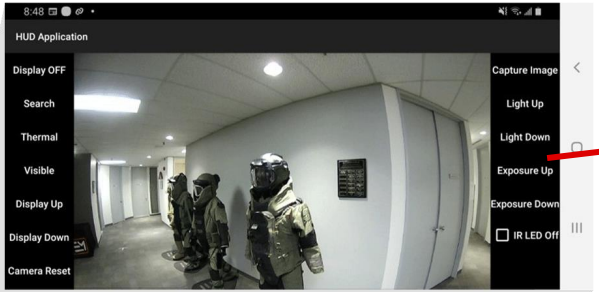


- Scalable approach
- Modest cost



IWTSD HUD – APP AND SMARTPHONE

Same image displayed on both HUD & wrist display



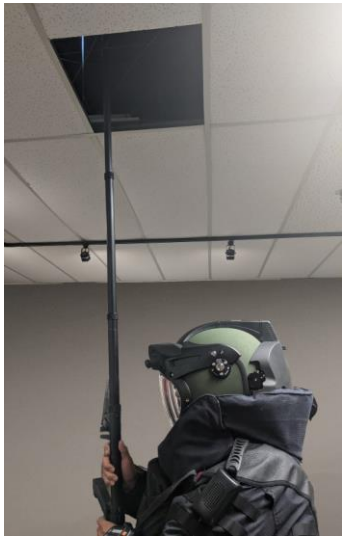
Voice Command Options displayed on HUD screen

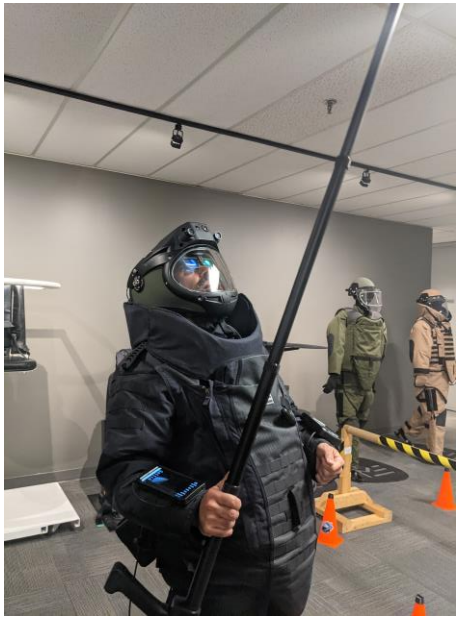
Galaxy Android with custom APP (wrist-mounted)

Touch-button Command Options displayed on wrist screen

REMOTE IMAGES DISPLAYED IN EOD HUD

Distribution Statement A. Approved for public release. Distribution is unlimited





HUMAN FACTORS TRIALS WITH HUD

Distribution Statement A. Approved for public release. Distribution is unlimited

Obstacle Course

Low light

Visor shade

NGABS HEADS-UP DISPLAY AND SENSOR SUITE

Distribution Statement A. Approved for public release. Distribution is unlimited

Med-Eng / QinetiQ

NGABS

***N**ext*
***G**eneration*
***A**dvanced*
***B**omb **S**uit*

U.S.ARMY

Visor Up

Visor Down

Visor Covered Augmented Reality

NGABS HEADS-UP DISPLAY – AR FOR EOD

Distribution Statement A. Approved for public release. Distribution is unlimited

- Modular & Scalable Bomb suit protection
- Multi-Sensor Suite (MSS)
- Heads-Up Display (HUD)
  - MSS sensor outputs display on HUD with user controls
- MSS & HUD mounted on combat helmet

Photo By Frederick Shear | Human Factors Evaluation with the 52nd Ordnance Group at Fort Campbell, KY

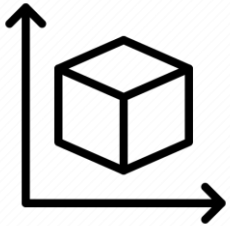
ESSENTIAL FINDINGS FOR USER ACCEPTANCE

- Seamless Integration in Helmet
- Easy to don/doff
- Respect C of G
- Avoid tangling
- Avoid duplication
  - Rely on suit power
- All controls integrated
  - *No patchwork*
  - *Central control*
- Adjustability to head/eyes
- Reliable operation

CHALLENGES EXPERIENCED FOR EOD SENSORS & HUD INTEGRATION

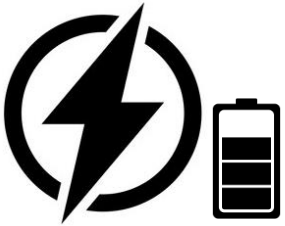
Weight

Bulk



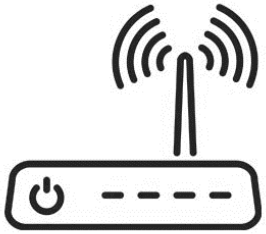
C of G

Power



Cost

EMI

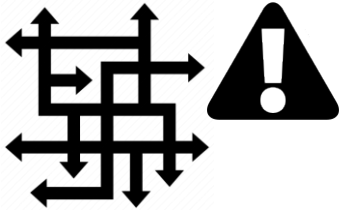


Reliability & Maintenance

Info overload/Training

Integration Complexity

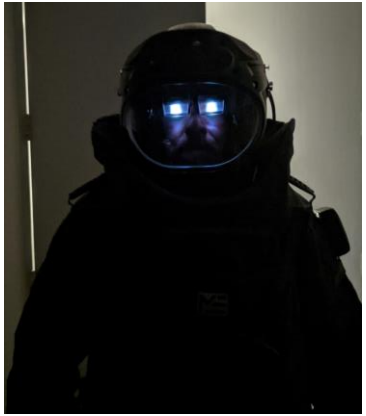
System Failure



SUMMARY FINDINGS – SITUATIONAL AWARENESS

Technology will enhance safety, versatility & performance in Operations

Lighting for Smoke/Dark



Night vision & sensor fusion - Non Permissive

SUMMARY FINDINGS – CONT'D

- Better information, many sources
- Available downrange in real time, hands-free and heads-up
- Enables more efficient decision making
- Provides a real advantage for the modern EOD operator
    - Augmented Reality

SUMMARY FINDINGS – CONT'D

EOD tech will be more enabled with Augmented Reality

- Display info on HUD to avoid diverting attention from the task

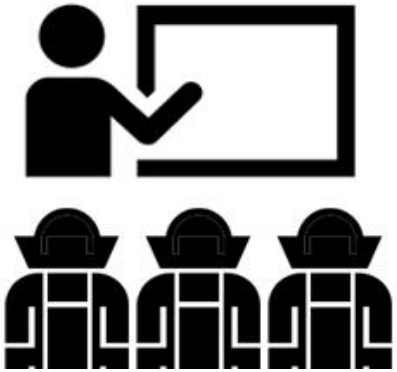
- Threat sensor data
- Camera images (visible, night, thermal, fusion)
- Communication exchange
  - Reach back to data base
  - Access ROV and UAV inputs
- Interoperability with other render safe equipment
  - X-Rays on HUD
- Layout of building
- Suit status (battery, air) physiological status

SUMMARY FINDINGS – CONT'D

But there are costs…

More expensive

More training



Higher Technology Platform needed

THE FUTURE…

Distribution Statement A. Approved for public release. Distribution is unlimited

- EOD will be beneficiary from “Big Army” technological investments & advances
- EOD operators taking over the night
- Technology is rapidly advancing for EOD

Use EOD visor as the display

-Full Augmented Reality

Not there yet!!

ACKNOWLEDGMENTS

IWTSD – Explosive Ordnance Disposal and Explosive Operations (EOD/EXO)

Contract 1: N4175617C4749 – 2017
Bomb Suit Heads Up Display (HUD)

Contract 2: N4175619C3063 – 2019
Glasses-less Heads-Up Display (HUD) in Bomb Suit Helmet

US Army NGABS Program – PM SPIE or PM SPE, PEO Soldier

Collaboration with QNA: W909MY-18-9-001 / SCEC-PLA-0023
Next Generation Advanced Bomb Suit (NGABS)

LEGAL STATEMENT

The materials contained in this presentation are approved for public release.

Distribution Statement A. Approved for public release. Distribution is Unlimited.

Med-Eng® is a registered trademark of Safariland, LLC.