Collaborative Development of a Mine Detection Training Device

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**Collaborative Development of a Mine Detection Training Device**

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• The Challenge
• Finding the Right Skills to develop the Training Device
• Collaborative Partners
  – Army Research Laboratory
  – Academia
  – Industry
• Funding Source
  – Leonard Wood Institute
  – Awarded on a Competitive Basis
• The Training Device
• Transitioning to the Army
AN/PSS-14 uses two sensors:
- Induction coil (metal detector)
- Ground Penetrating Radar (change in di-electric constant detector)

Can only detect what it passes over – every square inch of the lane must be swept with the detector head close to the ground

Employs internal algorithms that must be trained to soil similar to that to be searched

Requires relatively frequent recalibration

U.S. Army Combat Engineer with PSS-14 near Bagram Airport, Afghanistan, April 2004
• AN/PSS-14 Training
  – Learn detector switchology – start up, algorithm training, maintaining calibration
  – Learn to sweep – covering every square inch of the lane at the right sweep speed and with the detector height the right distance above the ground
  – Target investigation – with the metal detector and the Ground Penetrating Radar
    • How to convert the auditory information from the detector to a spatial image of the target in the ground, primarily based on the location of the detector head when the sound is emitted.
    • And to do so with such proficiency that they are willing to bet their life and others on their performance capability
• Studies have shown that the skill degradation of AN/PSS-14 operators significantly decline in as little as 30 days
• Development of good training lanes are very labor intensive and require expensive simulants
• Training is dependent on weather conditions
• Regular training is logistically prohibitive for many units – particularly Reserve Component units
• A simulator can address many of these training issues
Objective

- Develop a highly realistic Landmine Detection Simulator that closely resembles the form, function, and responses of the AN/PSS-14 built around an easy to assemble, operate, and low-cost platform.

- Required Team Skill Set:
  - Programming capability
  - Understanding of how the detector works
  - Understanding of what detector features are key to effective training
  - Understanding of how the detector is swept and output is interpreted
  - Ability to write the equations to define the appropriate auditory output for a variety of target types
  - Understanding of the human factors issues such that fidelity is appropriate
  - Ability to fabricate the prototype hardware
  - Knowledge of how to apply the most cost effective technology
Collaborative Team

- Industry
  - Advanced Military Equipment, Inc.
  - Advancia
- Academia
  - Missouri University of Science and Technology
  - Lincoln University
- Government
  - U.S. Army Research Laboratory
Funding Source

• Missouri S&T Submitted a proposal based on a Leonard Wood Institute solicitation
  – Leonard Wood Institute funded via a Congressional ad coming through the U.S. Army Research Laboratory
  – Proposal selected on a competitive basis
    • Technical Reviewers
    • Operational Reviewers
    • Academic Reviewers
    • LWI and ARL Reviewers
Sound Model Development

Process

- Utilizing buried clutter, simulants, and defused mines
- Frequency and amplitude readings were taken at incremental distances to the target
- Data was then plotted accounting for target depth and total distance
• Polynomial regression method of analysis
Simulated Detector features:

- Similar controls
- Similar size and weight distributions to provide same swing moment of inertia as the actual detector
- Four IR LEDs were attached to the mine detector head to identify its position and orientation.
Two Wiimotes were used to form a stereo system which provides 3D position of the mine detector.

The Wiimote stereo vision system is set at 45° relative to the vertical direction, 2 m from the ground, and the coverage is 1.6m × 1.8m.
Training Lane Set-up

1. Select Cell

2. Drag and drop mines

3. Press OK to finalize configuration
Benefits of the Simulator

- Relatively inexpensive
- Fundamental program could have other algorithms that define performance parameters of any other handheld detector plug in – thus would be comparatively easy to evolve device into a simulator for any of the different types of handheld mine detectors the Army uses
- Enables training indoors in a space as small as 6 by 10 feet
- Can focus training on the tasks that need to be trained
- Provides visual history of performance for the Soldier
- Enables tailoring the lane difficulty to the Soldier’s skill level
- Provides comparative performance over time
• The Army, academia, and industry all came together to produce a product that none of the agencies alone could have accomplished
• While yet unproven, there are reasons to believe the landmine simulator could improve efficiency of refresher training
• The concept can readily be adapted to any number of other handheld mine detectors
• The landmine simulator provides a new and innovative way to train handheld detection with the many advantages of simulation
• Though not being used now, it demonstrates what is possible in another area of simulation training