2004 Command and Control Research and Technology Symposium
The Power of Information Age Concepts and Technologies

TOPIC: C2 Human Factors Engineering

The Requirements and Applications of Speech Recognition Technology for Voice Activated Command and Control in the Tactical Military Environment

By

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Initial research into speech recognition technology

- Interactive Speech Technical Advisory Committee
  - All Uniform Services
  - Numerous Govt. Agencies (Agriculture, Post Office, etc.)
- Evaluate the effectiveness of COTS speech recognition technology for Avionic Command and Control.
  - NAP-of-the-earth flight
  - Hands & Eyes Busy
  - High Noise (98 dBA – 123dBA)
- Unassisted COTS technology failed to perform reliably at sound levels as low as 80dBA.
  - Various Noise Filtering approaches investigated
  - Additive Noise approach most successful

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The evolution of our speech recognition technology

- Fort Hood Database Collection
  - Apache (AH-1), Iroquois (UH-1), Kiowa (OH-58) & Mohawk (OV-1)
  - Various Maneuvers – Straight Flight, Banking Turns, Hover (In & Out of ground effect), etc.
  - Testing Communication Systems
  - Recording Ambient and Comm. Environments
- Noise Processing
  - Analysis of noise characteristic impact on recognition performance
  - Multi-Level approach to Noise
    - Noise Cancellation Microphone
    - Active Noise Processing
  - Current solutions address Quasi-stationary noise
  - New Solutions to Impulsive Noise in progress.

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The evolution of our speech recognition technology (Cont.)

- Gain Management
  - Sensitivity to Signal-to-Noise Ratio
  - Noise Cancellation Microphone Impacts Gain Management
  - Deterministic Automatic Gain Control
- Recognizer Activation
  - Conventional Press-to-Talk (PTT)
    - Comm. System Activated Side-Tone
  - Non-Conventional Press-to-OFF (PTO)
    - Unintended Vocalization
    - Word Switch
    - VR System Activated Side-Tone
- Audio Feedback
    - Command Completion Response
    - Command Interrupt Response on Error

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The evolution of our speech recognition technology (Cont.)

- Beyond Threshold Functionality
  - Whispered/Shouted Speech
    - Requires improved front-end dynamics
    - Currently achieved through re-enrollment
    - New technology will eliminate re-enrolment
  - Multiple Speaker Confusion Avoidance
    - Command Post Environments (Close Quarters)
    - Adjacent Voice Spillover (AVS)
      - Exacerbated by Far-Field microphones
    - New technology will reduce affects of AVS

SRS Comparative Testing

- Test Application: Brigade & Below, Command & Control (B2C2)
- Input Modality
  - Natural Speech Recognition
  - Isolated-Word Speech Recognition
  - Manual Entry
- Task – Call For Fire message
- Metrics
  - Task Completion Time
  - Accuracy
- 18 Test Subjects

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Test Configuration

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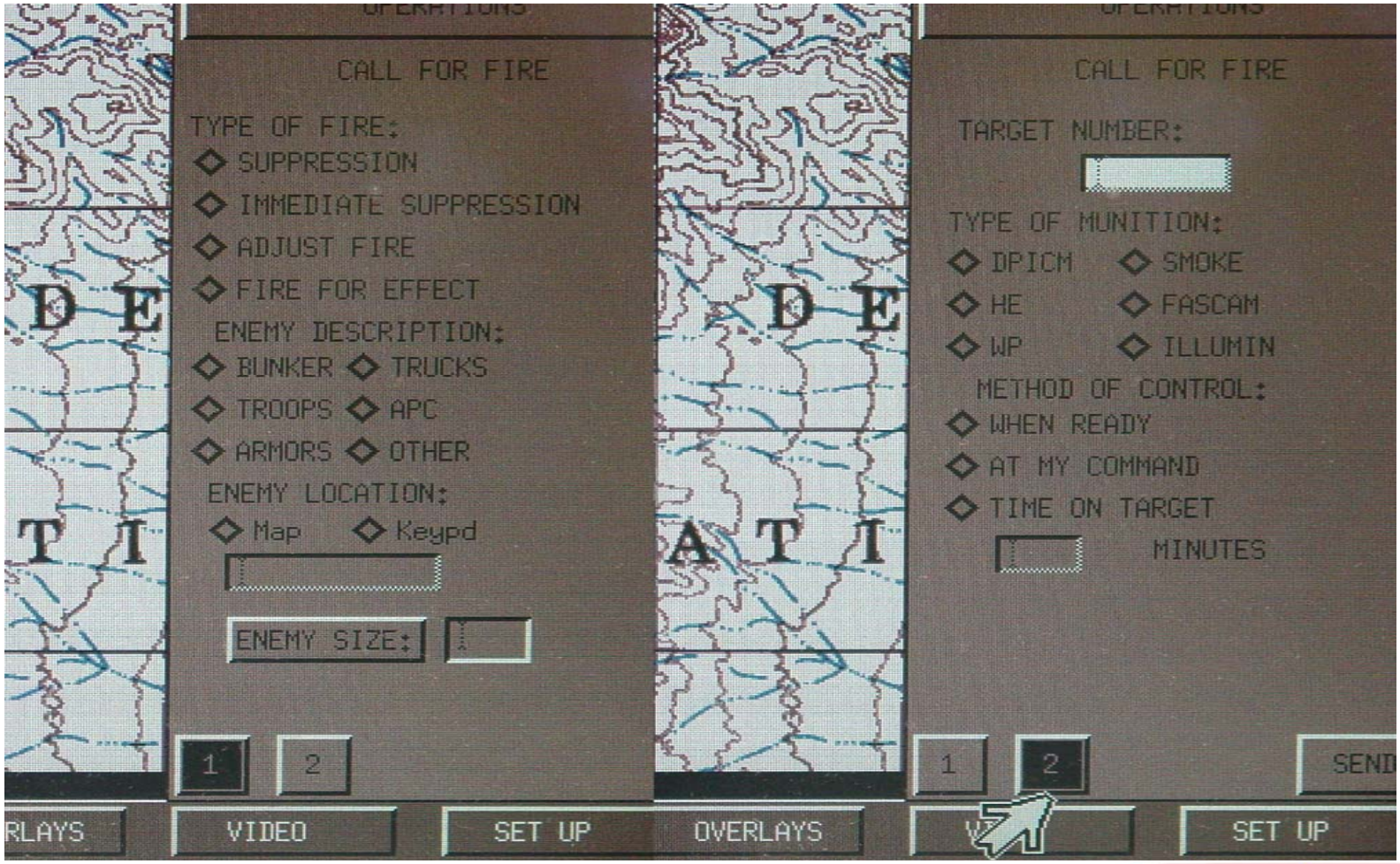
Call-For-Fire Task



Composite Image, CFF Pages 1 & 2

Comparative Test Results

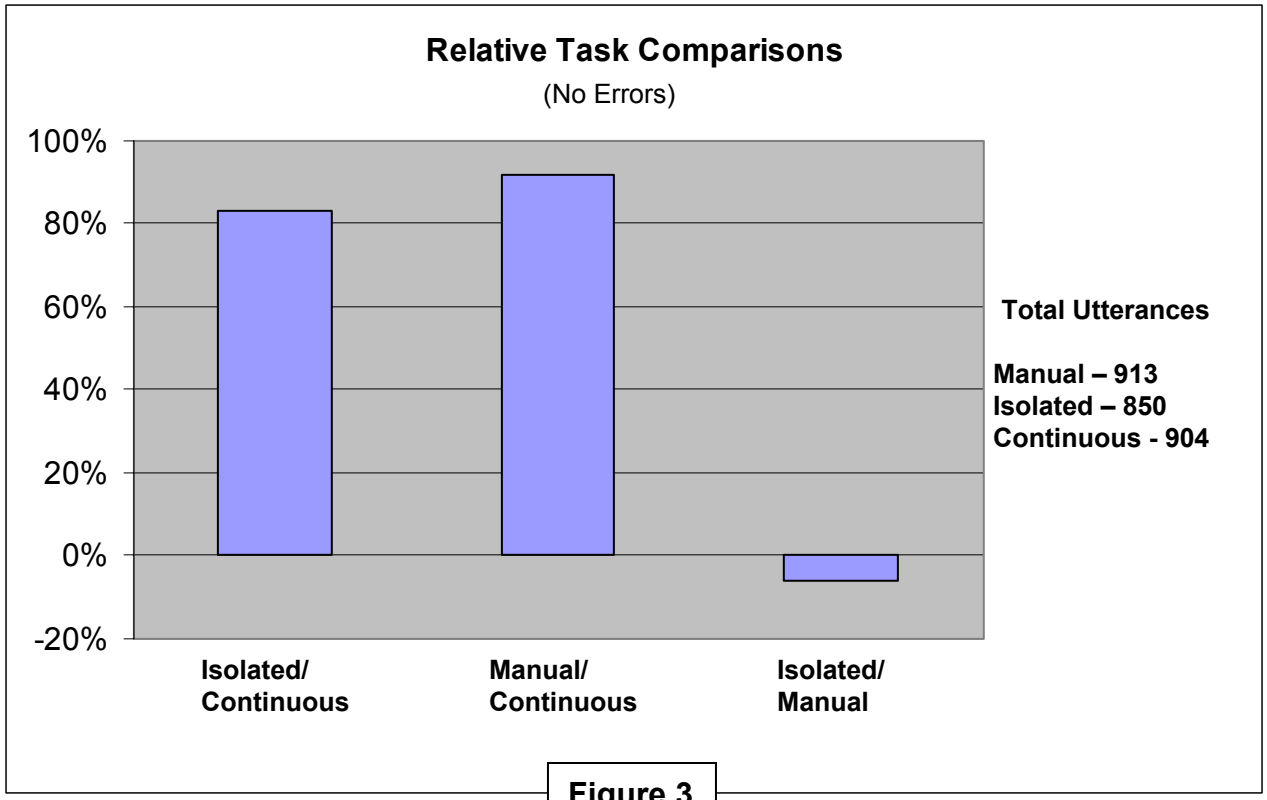


Figure 3

Comparative Test Results

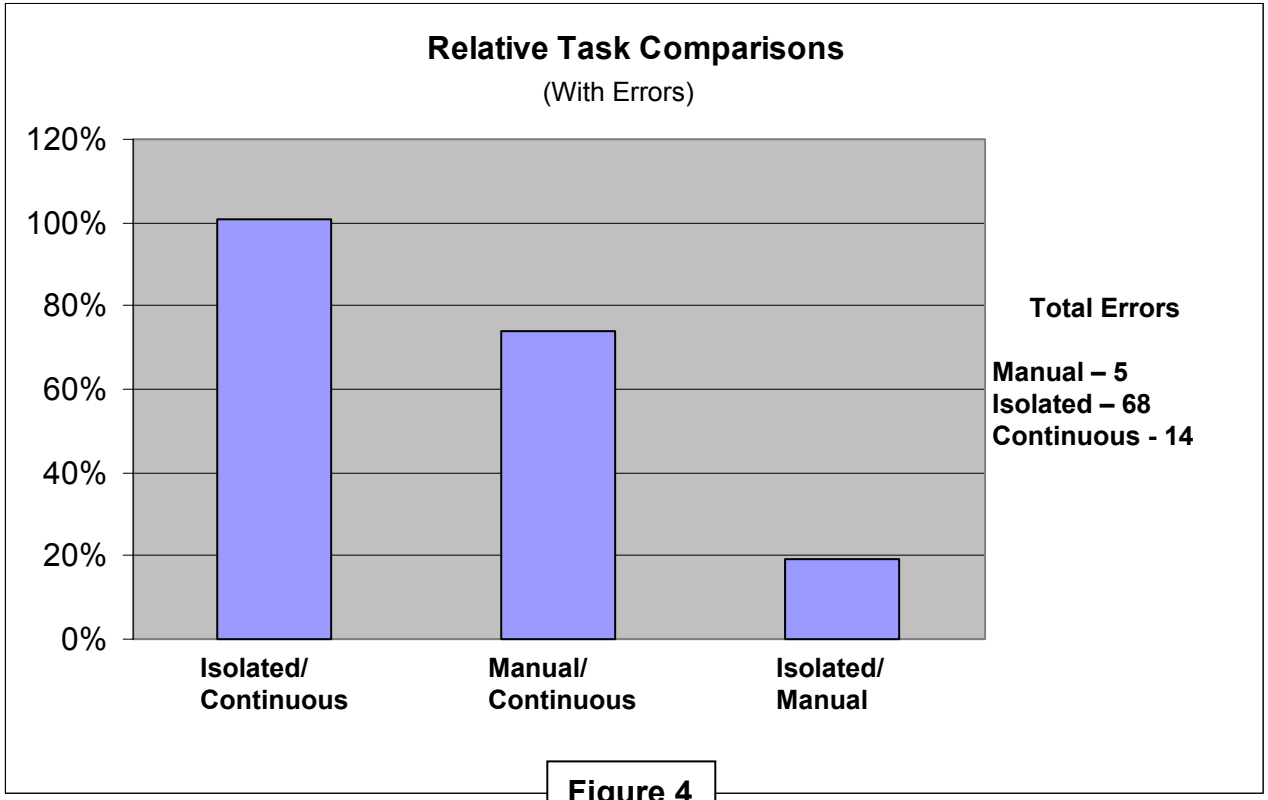


Figure 4

Subjective Questions

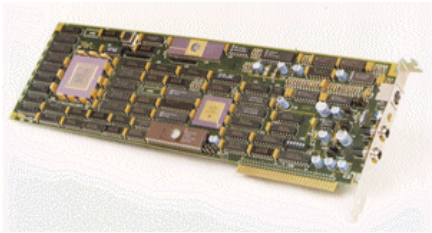
- How easy was it to use (continuous recognition, isolated recognition, and manual entry)?
  - Scale: 1 to 5, where 1 is easiest and 5 is hardest
  - Results: Continuous (1.3), Isolated (2.5), and Manual (2.3)
- How comfortable did you feel with (continuous recognition, isolated recognition, and manual entry)?
  - Scale: 1 to 5, where 5 is the most comfortable and 1 is the least
  - Results: Continuous (3.7), Isolated (2.5), and Manual (3.1)
- Speech Recognition was preferred over Manual Entry

Tactical Voice Activation System

Command Voice!™ All-Software Tactical Voice Recognizer

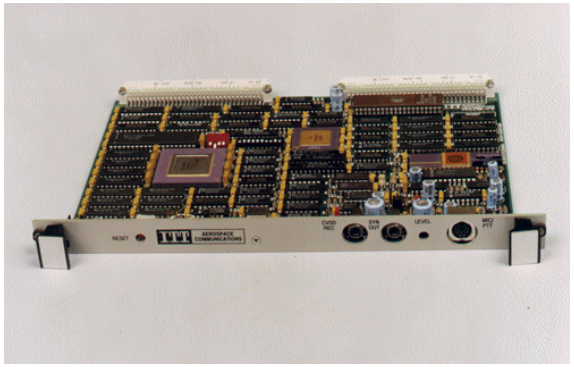
Command Voice!™ PCMCIA Tactical Voice Recognizer

Command Voice!™ Voice Application Toolkit



Command Voice!™ ISA Bus Tactical Voice Recognizer

Command Voice!™ SBus Tactical Voice Recognizer



Command Voice!™ VME Tactical Voice Recognizer

TVAS In ACTION

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In to the *Future*

OBJECTIVE: Intelligent Soldier/Machine interaction, providing increased accuracy, reduced task time, yielding greater Survivability and higher Lethality.

Advanced Cognitive Interactive Speech Technology (ACIST)

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