Aviator Training with Augmented Reality

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Purpose

• Discuss Augmented Reality from the US Army context.
• Talk about what worked and what didn’t work.
• Personal opinion not the representative of the US Army or AVT Simulation.
Briefer Background

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• Vice President Of Business Development for AVT Simulation – Not a Technical Guy– Experienced User of Augmented Reality Training
• Retired US Army Aviation Colonel with 25 plus years of active service, Aviation Brigade Commander, AH-64A/D, OH-58C, AH-1, UH-1
Background Terminology

Virtual Reality

Mixed Reality

Augmented Reality
Visual Terminology

- Field of View – What can I see right now, “Instantaneous”
- Field of Regard – What can I see around me (when I turn my head)
- Helmet Mounted Display (HMD) – A device that sits on or is mounted to your head that can send images to your eyes
Augmented Reality (AR) In Use

• The Aviation Combined Arms Tactical Trainer (AVCATT) is the US Army Aviation’s collective training system for Active, Reserve and ARNG aviation units.
• It is a mobile multi-station virtual simulation device that supports unit collective and combined arms training for helicopter aircrews.
• It is composed of two trailer suites with four reconfigurable modules for:
  Apache    Blackhawk
  Chinook    Lakota (RC only)
• The AVCATT uses AR Helmet Mounted Displays (HMD) for out-the-window scenes.
Augmented Reality (AR) In Use

• AVCATT began fielding in 2001
• No motion system.
• No large visual display.
• A 360 degree Field of View (FOV) visual display is desired for helicopter combat training.
• Simulator’s cockpit controls and instruments reconfigurable for each aircraft type
• Space in the two trailers for the six simulators, an AAR debrief room and space for the Battlemaster Control room
• 23 total in inventory usually at Brigade level
• Linkable with Close Combat Tactical Trainer (CCTT) for Air-Ground Integration
Why Collective Training? Battle Drills
(Shoot, Move, Communicate)

- Downed Aviator “Fallen Angel”
- Pre Cautionary Landing
- Troops in Contact
- Quick Reaction Launch
- Surface to Air Missile launch
- ROE Violation
- Medevac
- Mass aircraft recall
- HVT sighting
- Indirect fire on FOB
- Downed UAV

Train the Staff!

Train your LTs!
Air Mission Commander Training
Augmented Reality (AR) In Use

- AVCATT considered Virtual Reality but they wanted pilots to be able to see cockpit controls
- AVCATT instead includes an Augmented Reality (AR) Head Mounted Display (HMD)
  - AR HMD allows seeing though the display window and adding imagery to or taking away imagery from the HMD display field of view
- HMD used for training Army helicopter pilots for the last 17 years in simulation
- Current AVCATT Study in work to plan for HMD upgrade

Kaiser Electro-Optics
SIM EYE XL 100A HMD
Augmented Reality (AR) Selection Criteria

• Considerations for New AVCATT Study
  – Head-supported weight and balance
  – Display resolution
  – See-through transmission
  – Image luminance
  – Image contrast

• Other Considerations
  – Horizontal and vertical field-of-view
  – Binocular overlap
  – Eye Relief distance
  – Exit Pupil diameter
  – Focus and convergence distance
  – Vernier adjustments for fitting and sizing
  – Interpupillary distance adjustment
Poor Design Unintended Consequences

Divergence

Excessive Convergence

Dipvergence
Augmented Reality (AR) In Use

The Good  
The Bad  
The Ugly
Application of AR

• AVCATT HMD is “head tracked”
  – The OTW imagery can be displayed anywhere the pilot turns his head
  – Pilot has a full 360 degree Field of Regard
  – The OTW image appears in his AR HMD anywhere his aircraft windows allow it … including the chin windows

• How is it done?
  – The Image generator has an internal mask of the cockpit windows to eliminate the OTW imagery anywhere there is the cockpit interior structure. No pixels over the instrument panels.
  – The head tracking allows the OTW imagery to appear collimated (i.e. virtual collimation) and be stereo within the central 30 degree binocular image overlap.

• This AR HMD implemented concept provides an amazing display system capability potential with in a very small footprint.
- Train as you fight
- Haptic is not there yet – thumb force controller test
- Cameras on the MR has too much lag / overlap
- I want to see my kneeboard with the naked eye and a lip light
Wrap up

• AR HMD technology has been a critical technology to the success of this US Army Program.

• It proved that this AR technology could provide the equivalent of a large simulator display capability into a training system that needed a small footprint.
  – AVT Sim has 1 AH-64 in 3 pelican cases check bags.

• The small footprint solution contributed to the ability to have a training asset that can be relocated and quickly set-up for operation to train flight crews of a variety aircraft types for proficiency in combined arms missions. Point of Need.
References

• References:
• Pictures from https://www.peostri.army.mil/aviation-combined-arms-tactical-trainer-avcatt-
• Conversations with Walt Chambers and Kyle Crooks, AVT Simulation