Increasing Situational Awareness via UAV Video Feeds in GIS Applications

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Overview

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Abstract

With the emergence of UAVs and the video payloads available onboard, the integration of sensor data into a common framework referenced in a geodatabase is becoming more desirable. The USAF Academy's Unmanned Aerial Vehicle (UAV) Research Group, a 25-member multi-disciplinary team, and the Academy's Geo Integration Office are developing a prototype UAV Situational Awareness tool that will connect the commander in a command center to the video feed from an operational UAV. The prototype is being built as an ESRI ArcObjects extension for ArcGIS 9.0 that displays a moving UAV on the spatial data from the geodatabase and streams the video data to an embedded video viewer in the map. The result is a fusion of the UAV's location and video feed into a common frame of reference. Using this tool in a command center during dynamic situations will increase the situational awareness of Air Force Commanders.

Purpose

- Connect Air Force commanders to UAV video feeds
  - Real-time feeds from operational UAVs
  - Increases situational awareness during dynamic situations
- Combine existing technologies
  - GIS systems, ArcGIS, ArcMap, etc.
  - UAV video feeds, EO/IR
  - Networking technologies
- Developing a prototype system

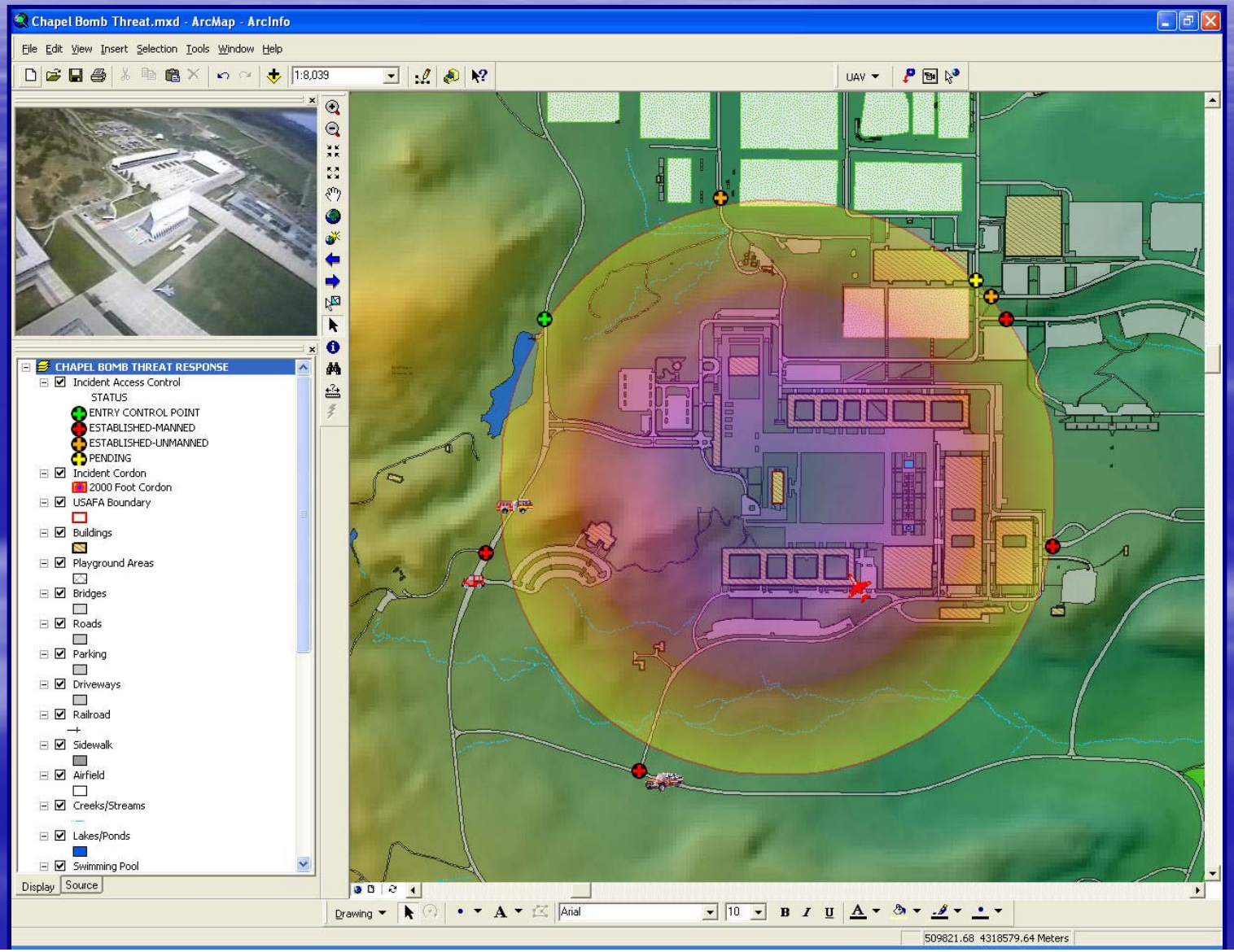
Background

- US Air Force Academy
  - Undergraduate institution with around 4000 cadets
  - 32 different majors including aeronautical and computer engineering
- UAV Research Group
  - 25 members from 11 different disciplines
  - $100K budget this year
- USAF Academy Geo Integration Office
  - Integrating GIS across the base

Background

- Red Hen Systems
  - Video capture and playback via GeoVideo™
  - Not real-time
  - Geo-referenced DVD video captured in flight
  - Replay video in ArcMap application
- University of Nebraska gNet
  - Interactive map of Lewis and Clarke explorations
- Iwane Video GIS system
  - View videos of selected locations, but not real-time

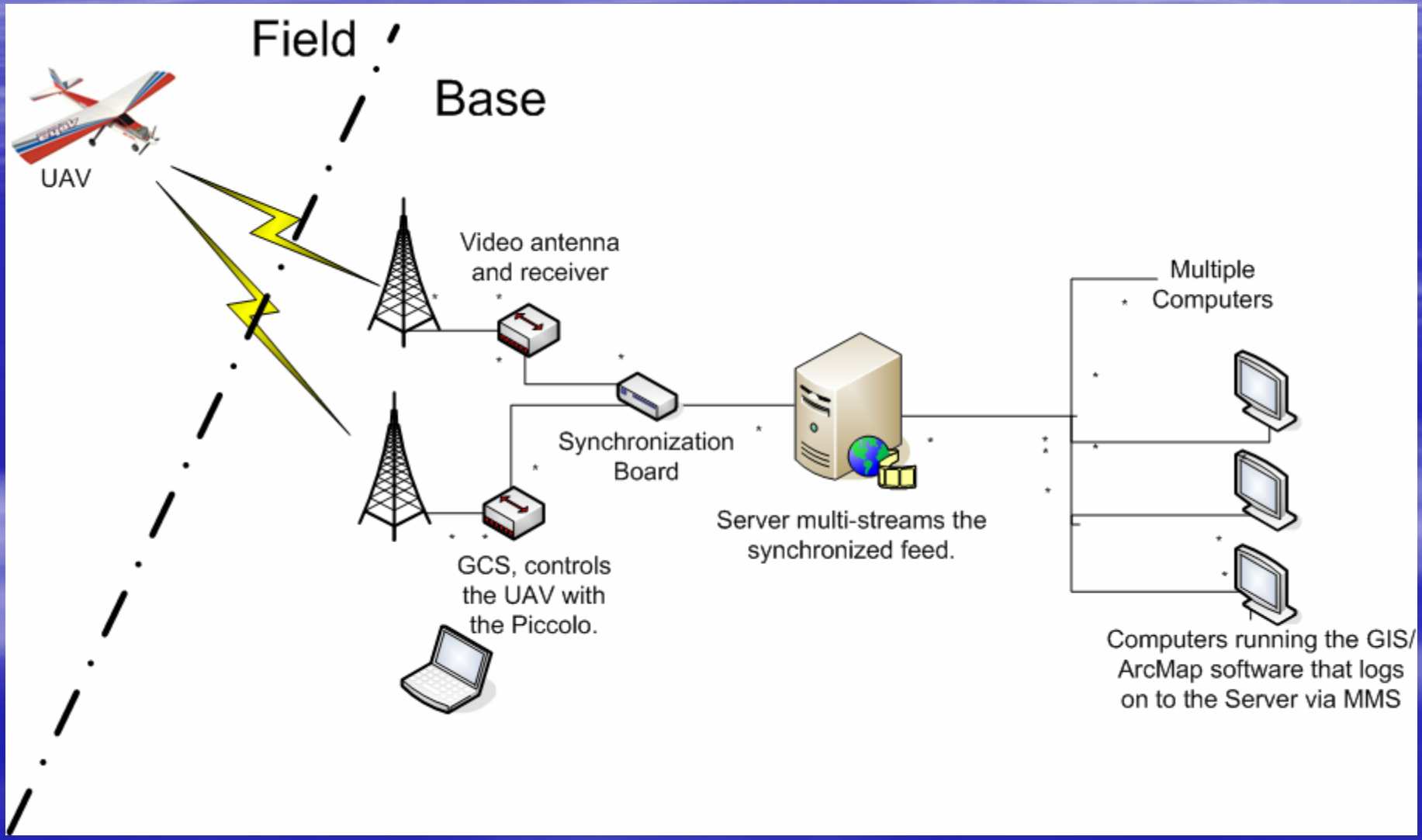
UAV Situational Awareness Tool



UAVSAT Client Server Architecture

- Airborne UAV captures video and telemetry
- Currently on separate wireless feeds
- Server computer
  - Connects to Ground Control Station (GCS)
  - Connects to video feed
- Client computers
  - Log into secure web site

Client/Server Architecture



UAVs at the Academy

- Silver Fox
- Desert Hawk
- BATCAM
- Predator Engine testing
- Alpha 60

Results

- Current prototype based on ArcMap
  - Includes detachable video streaming window
  - Based on Microsoft's Windows Media Player
  - Able to connect to UAVSAT via IP and stream video
  - Can display UAV on geo-referenced map
- Next release
  - Update UAV's position in real-time and move icon
  - May use Tracking Analyst
  - Tracking Server sounds promising

Challenges

- Synchronizing video and telemetry
  - 10 second delay
  - Need to match location with video
- Investigating onboard solution
- May synchronize on the ground

Acknowledgements

- This research has been funded by a grant from the Institute for Information Technology Applications (IITA) at the Academy
- Thanks go to Cadet Nick Brownheim and the cadets in the Software Engineering course for their work on the UAVSAT tool

References

- [1] Red Hen Systems, Inc. *GeoVideo Brings DVD Video to the ESRI ArcGIS Mapping Environment.* Retrieved from http://www.redhensystems.com/ on 2 December 2004.
- [2] University of Nebraska. gNet interactive mapping system. Retrieved from http://www.lewisandclarkgnet.com/index/ on 2 December 2004.
- [3] The Iwane Video GIS system. Retrieved from http://www.iwane.com/old/ eiwane510.html on 2 December 2004.
- [4] Cloud Cap Technology, Inc. Piccolo autopilot system. Retrieved from http://www.cloudcaptech.com/default.htm on 12 January 2005.
- [5] Advanced Ceramics Research, Inc. Silver Fox UAV. Retrieved from http://www.acrtucson.com/UAV/silverfox/index.htm on 12 January 2005.
- [6] Aerosonde Corporation. Aerosonde UAV. Retrieved from http://www.aerosonde.com/ on 12 January 2005.

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