Improved Situational Awareness through GIS and RFID in Military Exercises

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Abstract

The Battlefield of today is often in urban areas with high-density population and strategic infrastructure that can predicate advantage and determine the success or failure of the conflict. In an effort to better equip the warfighter in these environments, the Soldier Battle Lab's (SBL) McKenna MOUT facility at FT. Benning GA has established an instrumented urban environment that facilitates the collection and analysis of data that will ultimately impact the training and equipment our soldiers fight with.

As part of the SBL's experimentation and prototyping mission at Ft. Benning, PraxSoft developed and integrated a 2D GIS-enabled application with buildings, terrain, an RFID tracking/asset management system and live soldier entities. An extension was written to ingest real-time data via the Distributed Interactive Simulation (DIS) protocol to communicate with a non-GIS mapping system. Work is currently being done to integrate the 2D GIS application with a 3D-Viewer to allow improved situational awareness.

Background

In today's modern military environment more and more emphasis is being placed on urban environment tactical training. The U.S. Army has undertaken military Operations on Urban Terrain (MOUT) since its inception. However, the complexity of the terrain and the shift of population to urban areas have increased exponentially throughout that time. According to an article at global security.org (http://www.globalsecurity.org/military/ops/mout.htm), the world is largely situated in an urban environment and it is estimated that by the year 2010, 75% of the world's population will live in an urban environment. Additionally, large conventional wars, while still a major threat, are not the current focus of military operations.

With the end of the cold war, there has been a shift in paradigm from a large, heavy force to a light, reactionary mobile force. This is evident with the transformation of the U.S. Army through the Future Combat Systems program. Along with this real world change in operational context, comes a change in importance of training systems. While simulators and training devices for heavy armor and other military systems remain important, a greater emphasis is being placed on dismounted soldiers in an urban terrain setting. So how can more

technologically advanced training and implementation strategies improve the protection of these forces?

The U.S. Army believes they should “train as they fight, fight as they train”. Other branches of the military have similar views. Within the context of that theme, exercises in a military environment provide the most realistic scenario for training possible to the soldier. The soldiers are trained in tactics, situational awareness, and command and control in an urban environment. Understanding the environment that the soldier must fight in and implementing technologies that allow real-time data collection of the soldier’s position, location and status to evaluate performance is paramount to success. Comprehensive understanding of the urban environment through 3D visualization and real-time instrumentation and how to interact within it, is the goal of training exercises held at facilities like Ft. Benning’s MOUT McKenna site. The inclusion of these types of technologies provide more accurate, up-to-date situational awareness and help make both training and tactical missions successful while improving force protection. There are multiple MOUT training environments around the world in addition to tactical deployments that would benefit from such an enhanced training and instrumentation system.

Technology in Urban Training and Combat

Technology is a key enabler in helping train the soldier. Combat in urban areas, especially with all of the threats of the modern conflict, is dangerous. Protecting forces and enabling them to be effective requires the proper tools. One of those tools is experience. Soldiers gain experience from training exercises and experimentation and the technology that drives it. As an added benefit, often the technology that is used in training environments is transitioned into operational environments.

Military training exercises in today’s world are almost always a combination of natural and synthetic environments. The Live-Virtual-Constructive training methodology allows for interaction of live forces with assets, enemies, and obstacles that may not actually be present, but provide the resources necessary to train with. Live dismounted interaction with virtual aircraft or virtual artillery units; for example, facilitate complete training environments without the need for additional units or potential live-fire training accidents.

Technology within the live portion of the exercise provides a more robust training experience. Using technologies like GIS, GPS, mesh-networking and RFID, soldiers are tracked both indoors and outside while engagements between forces are captured in full-motion video. Digital After Action Reviews (AARs) allow the soldiers and their commanders to replay the events and critique the performance of individual members of the unit.

Technology also allows the soldier to experiment with new systems that may enhance their capabilities in a combat environment. Insertion of systems like enhanced situational awareness, soldier tracking, and 3-D visualization allow the soldiers and their commanders to experiment with emerging technology in a realistic training environment.

McKenna MOUT Implementation

Ft. Benning's McKenna MOUT is one of the premier facilities for training the soldier in urban tactics. The facility has a state of the art technology infrastructure and this allows live exercises to be held in conjunction with virtual support training from remote centers such as Ft. Rucker and Eglin Air Force Base. The facility is outfitted with indoor and outdoor tracking for soldiers and utilizes MILES compatible equipment for force on force interactions. The information associated with the soldier's position, location and status is relayed back to a control room for visualization in Command and Control systems and logged to enable play back for post-exercise analysis.

Enhancements to this system are always being made and a recent addition to the technology is a joint Praxis Software Inc (PraxSoft) and D&S Consultants Inc (DSCI) solution to provide a more robust situational awareness tool for mission planning, mission execution, and after action review. This system is comprised of hardware and software for the collection, processing, and display of real time location-based asset and personnel data. It includes a 2D GIS application and personnel/asset management system developed by PraxSoft that reports information in real-time using ESRI's ArcGIS coupled with a 3D Visualization solution developed by DSCI which provides a realistic 3-D environment for the MOUT site visualization of virtual entities. These systems comprise a complete solution for preparation and planning of urban missions, visualization of the execution of missions, and a take home after action review system for follow-on training actions.

2D GIS and AssetActive

PraxSoft, in conjunction with the McKenna MOUT, chose to implement the 2D GIS as an extension to ArcGIS™ since ESRI has taken a leadership role in the GIS industry during the past several decades, The 2D GIS application acquires data from a UDP connection in DIS format, processes the data and plots information in real-time using ESRI's ArcGIS. The system shows "entity" and "status" information from Live, Virtual and Constructive entities atop standard GIS layers such as roads, waterways, terrain and buildings. High-resolution aerial photography in the McKenna MOUT facility is also incorporated to gain a more accurate visualization of location and environment.

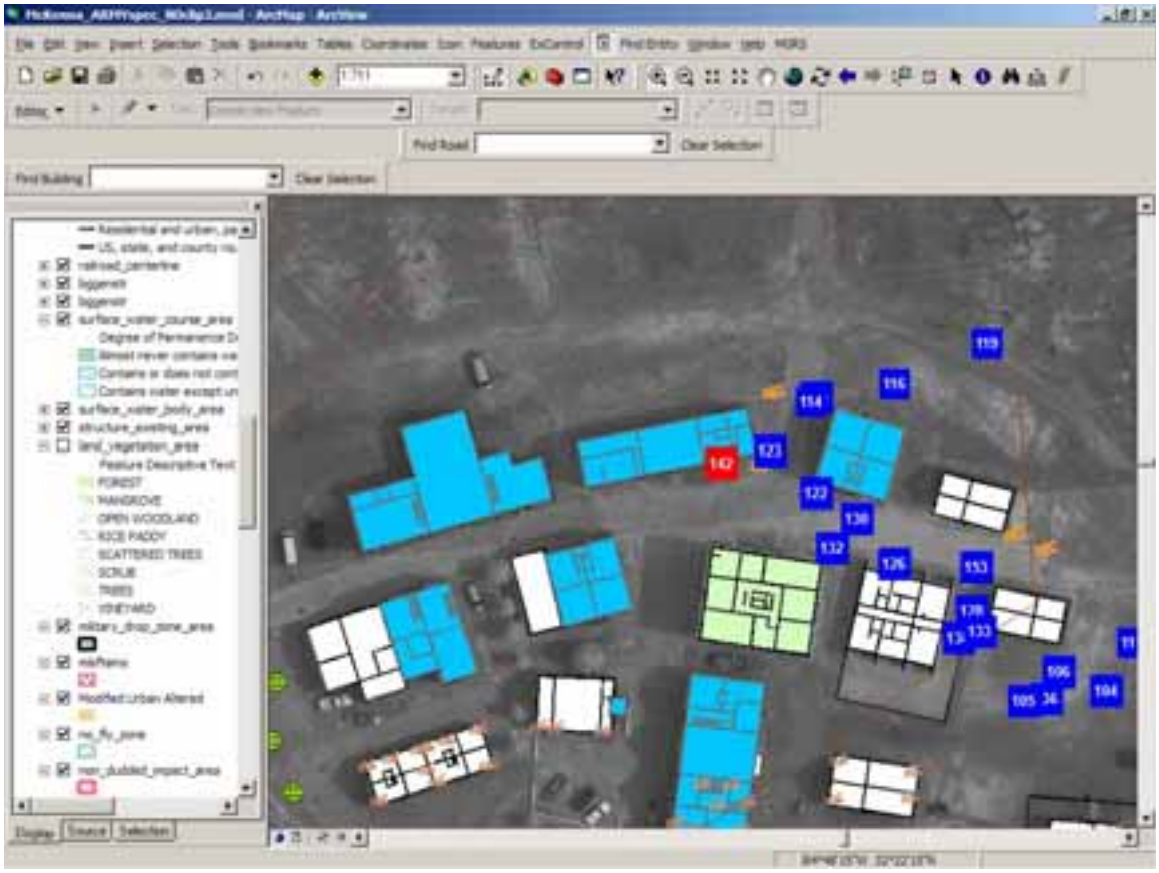

Figure 1 McKenna MOUT with building layer overlay, soldier tracking and live fire

The system is used to give Commanders and their counterparts a tool for improving situational awareness during exercises and experimentation. Not only can they see their units, status and movements, they can track live fire, soldiers, vehicles, other entities and assets in real time. They can easily distinguish BLUEFOR, REDFOR and gain insight on mission progress. They can locate "Hazard" areas, see live video and move to viewpoints within the 3D application, They can even watch as soldiers enter buildings then turn on or off CAD floor plans or other layers using PraxSoft's AssetActive™ system.

AssetActive integrates automatic identification using patent-pending RFID technology, authentication, position location information, sensor technologies, GIS and communications to enable monitoring of assets, personnel and potential hazards in real time. **Asset*Active*** allows the integration of active and passive RFID tags, GPS, and on-board sensors to provide seamless tracking of assets and personnel both inside and out. Local and remote alarms are built-in to provide business rule and user-definable alerts.

In conjunction with the DSCI's 3D Vision™ system, AssetActive and the 2D GIS provide a comprehensive mission and battlefield assessment through display in a LVC environment

Vision

The DSCI Vision application is an Image Generation (IG) system used in 3-D simulators for the Department of Defense and commercial entities. A customized application was developed around the core IG product for the Ft. Benning MOUT site to be used primarily as an after action review (AAR) tool. However, it's coupling with the PraxSoft 2D GIS application has allowed it to also be used as a unique situational awareness tool and planning and preparation tool for experimentation. There are 5 unique components to this application. They are:

1. **The 3D Viewer**: This is the heart of the application and it performs the rendering of the MOUT McKenna village in a 3D environment. It also renders all of the entities that are in the village in a 3D environment, and renders effects such as detonations and explosions. This portion of the application allows for modification of the models that will be visualized and also allows for unique face mapping of soldiers to their respective models. Additionally, Vision supports layers of the visualization system that can be toggled on and off by the 2D GIS software. This allows users and commanders to visualize the environment without roads, foliage, utilities, etc.
2. **The 2D MAP**: This component allows situational awareness and understanding of the environment by displaying 2D icons over imagery, CADGR, or other NGA products. This allows a top-down view of the exercise and allows for customized icons that are used to represent the entities in the exercise. The map also provides the ability to turn on trails to the entities and get specific information that was entered through the order of battle simply by clicking on the entity.
3. **The Order of Battle (Entities):** This component allows unique referencing of entities and allows a more detailed set of information to be associated with a particular entity. Hierarchies can be set up to represent echelons of command and control. Points of interest and camera views are also saved here. In addition, this is where real image face mapping to virtual models is performed.
4. **The Radio:** The Radio allows the user the ability to talk to other digital radios on the network or to soldiers in the field using actual RF radios. This is achieved through the use of 3rd party hardware called a radio bridge (from ASTI systems). Additionally, the radio works with any simulation system that utilizes mulaw, PCM, or CVSD encoding standards.
5. **The Logger:** This component allows the user to record all DIS information as it enters the system; this includes voice and entity information. The application can then replay the saved exercise for AAR, or even rebroadcast onto the network so that other simulations may see the information. The logger also records all of the camera movements during the event for later playback.

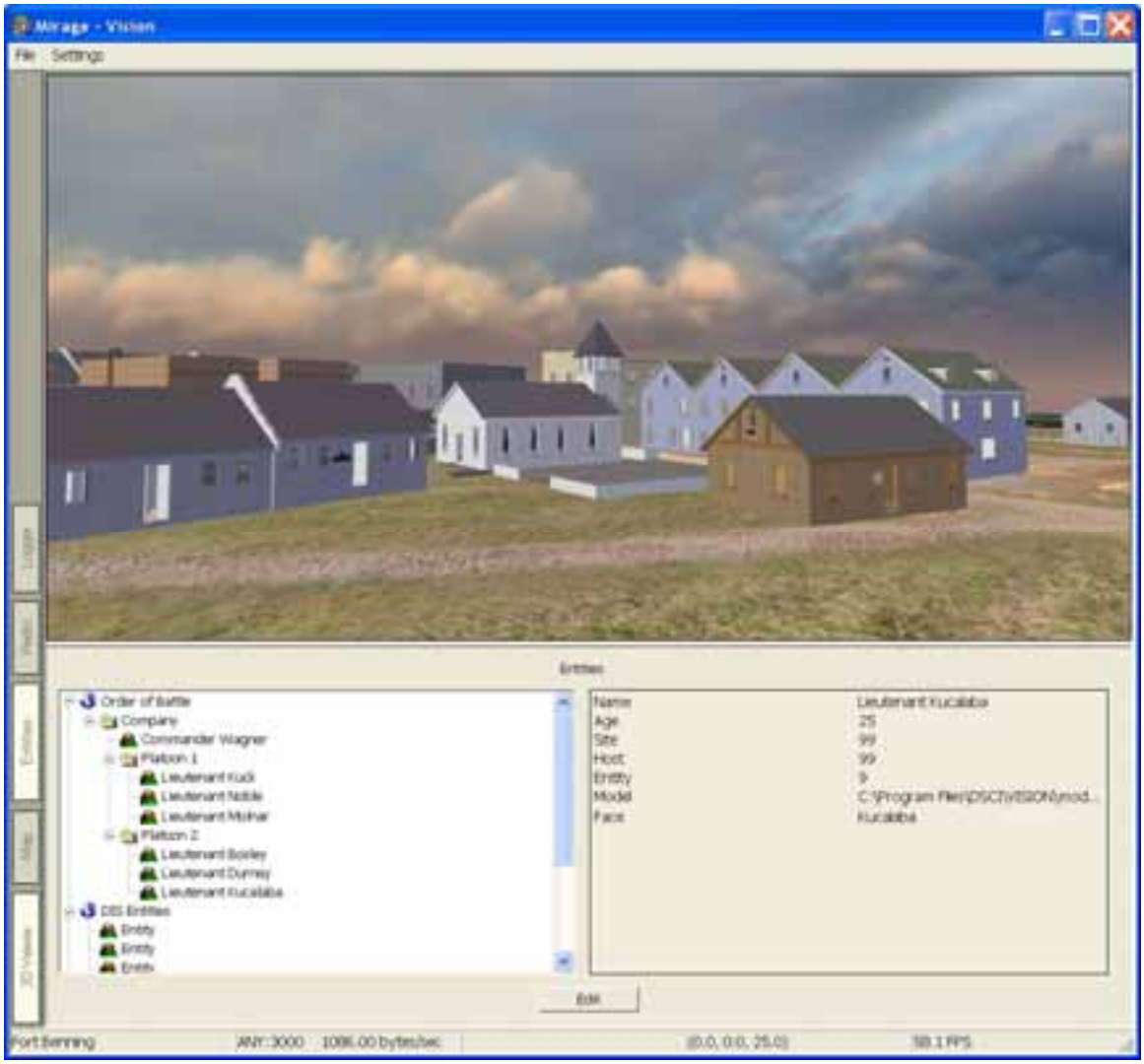

Figure 1. DSCI's Vision After Action Review Tool

Figure 2. DSCI's Vision With Tracked Entities in the Rain and the Viewpoint Controlled by the 2D GIS application

Acknowledgments

This paper was written with input from the staff at the Ft. Benning MOUT McKenna site, currently under the direction of Major Chase Martin (USA).

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Eric Wagner received a BS in Computer Science from the Ohio State University (cum laude) and has numerous graduate credits from Auburn. He has over 10 years of experience in the modeling and simulation environments of the Department of Defense. While employed at Southwest Research Institute, Mr. Wagner worked in the modeling and simulation division and was a software engineer and later a large scale program manager. Most recently with DSCI, Mr. Wagner is the commercial products division General Manager and the technical director of the Systems Integration Division. Mr. Wagner serves on multiple modeling and simulation

committees and is heavily involved in the Future Combat Systems (FCS) Modeling and Simulation Management Office (MSMO).

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Rhonda Copley has over fifteen years of combined computer experience with responsibilities including forging corporate alliances, managing software development projects, building applications development teams, scheduling product releases and providing research and development input. In her current role, Rhonda is responsible for developing strategic business alliances and the overall functioning of PraxSoft. Prior to establishing Praxis, Rhonda gained experience with hardware and software technology at Tektronix, Inc. and Sun Microsystems. She also served as an instructor at the University of Dayton. Rhonda has a Bachelor of Science degree in Electronic Engineering from the University of Dayton. She has also completed several MBA, communications and media classes.