HAMMER Combines RFID, GPS, Mapping, Sensor Technologies

Several years ago, Tad Britt, an archeologist and senior researcher with the U.S. Army Corps of Engineers, was out in the field fumbling with the many digital tools of his trade—a GPS receiver, a PDA and a digital camera—when an idea occurred to him. “I thought it would be great,” he recalls, “if all of

these devices could be integrated into one device.”

To that end, Britt helped establish a cooperative research and development agreement between the Army Corps of Engineers’ Engineer Research and Development Center, in Champaign, Ill., and the product engineering firm Compass Systems, based in Lexington Park, Md. Through their efforts, and with the important addition of an RFID component, his kernel of an idea has now reached fruition.

Tad Britt, from the U.S. Army Corps of Engineers, demonstrates the HAMMER.

Britt’s first vision was for a device that he could use to track the location of artifacts at archeological digs, which he had traditionally marked with bar-code labels. In addition to a PDA, which would provide memory and computing power, GPS to track the artifacts’ location, and a camera to capture their images, the device also needed a bar-code scanner. Over time, however, Britt and Compass Systems project manager David Bjornberg realized they could create a system that would not only track the location of bar-coded artifacts, but also map the archeological sites. They also discovered that networks of

sensors and RFID tags could act as eyes and ears to watch over the sites. Therefore, they decided, an RFID reader and sensors with integrated RFID tags would have to fit into the multitool they were creating, as well.

The result of this collaboration is the Hand-held Apparatus for Mobile Mapping and Expedited Reporting (HAMMER). Britt plans to begin using the HAMMER this year to analyze archeological sites on military land near Cape Canaveral, Fla., and on Catalina Island, off the southern California coast. His intention is to install a network of seismic sensors throughout both sites, using the HAMMER to write the geospatial location of each tag to the tag's memory. The HAMMER determines the tags' geospatial coordinates, as well as the location of any other artificial and natural features in the landscape researchers might choose to map, by using a combination of integrated sensors and a laser rangefinder, which reflects a laser beam off a tag or feature and measures its latency.

To create maps of the area, the HAMMER imports this geospatial data into an embedded geographical information system (GIS) software platform from ArcGIS, which runs on the unit's Windows XP operating system. The device can then upload this location data, as well as maps, to the 32 kilobytes of reusable memory on each tag.

The seismic sensors are built to detect any vibrations in the soil and report them to the UHF (915 MHz) active RFID tags to which the sensors are attached. These tags are manufactured by Identec Solutions, a provider of active tags and interrogators that use a proprietary air-interface protocol. An Identec Solutions embeddable RFID reader module is integrated into the HAMMER, as is a reader antenna, which can communicate with an Identec tag from up to 100 meters distant. Using a mobile bar-code printer, Britt can also create ID stickers to affix to artifacts on site, or use the HAMMER's bar-code scanner to read the data from artifacts that have already been marked

with bar-code labels. In the future, passive RFID tags could be used to identify artifacts, but this would require that a passive RFID reader be added to the system. Britt says that once the sites are mapped and tagged, he will save that information to the tags' memory. Thus, as long as other archeological crews have access to a reader able to pick up that data, they will be able to visit and examine the site without first having to perform all the mapping work he will have already completed.

Brit says he may return to the sites at a later date and upload sensor data from the tags to determine whether the sites had been disturbed by digging, or from vibrations caused by military trucks driving too close to the sites. Timestamps saved on the tags, he explains, would tell him when the disturbances occurred.

A network of seismic sensors can be installed at the archeological sites to work with the HAMMER device.

But the possible applications for the HAMMER, Britt and Bjornberg explain, extend well beyond those of Britt and his team of archeologists. "The HAMMER is the bedrock of the platform," says Bjornberg, "but it could be used with [tags linked to] any kind of sensor. Radiological sensors,

proximity, temperature or acoustic sensors could be used."

Bjornberg adds that the HAMMER has a modular design that will allow end users to add or remove many of its components. They might decide, for instance, to retrofit the HAMMER so it can communicate with sensors communicate using the IEEE 802.14 ZigBee standard for wireless personal area networks.

According to Bjornberg and Britt, engineers, military planners, emergency first responders, intelligence analysts, public works officials, environmental scientists, natural and cultural resource managers, surveyors, compliance officers, risk managers and real property managers are all among the possible end users for the HAMMER.

Compass Systems has filed a patent for the HAMMER and is presently looking for the funding or manufacturing partners it would need to bring the device to market.