The iPIX Mapping System

GIS with a 360° View

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Traditional manual methods of linking GPS points to a digital image involves traveling to the field, pulling out the GPS, taking a reading, writing the reading in a notebook, taking out the camera, shooting, and recording the picture numbers, topics and GPS project name. Back at the office, one then has to decipher and pull all the written information together in a GIS to set up hyperlinks from each GPS position to the proper pictures. It's not an impossible task, but a very time consuming one.

Enter the iPIX Mapping System with Red Hen's MediaMapper. With the iPIX Mapping System one must perform many of the same steps, but certain key points are automated. Essentially, the Red Hen product takes care of linking GPS data with photos, while iPIX hardware and software components add the ability to incorporate 360° × 360° images for an immersive view of a position's surroundings. These 360° images are the same views many hotel Web sites use to showcase their facilities or rooms.

Having previous experience with Red Hen's MediaMapper (See "Instant Replay: Red Hen's Multimedia GIS," in *Geospatial Solutions*, October 2001, p. 45) we decided to test the iPIX Mapping System's capabilities for producing rich media documents with explicit spatial content.

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The iPIX (www.ipix-i.com) Mapping System comprises hardware and software components to link 360° images to maps to provide an immersive visualization of a feature or plotted GPS position. Several iPIX hardware packages are available. The complete package includes a Nikon (www.nikon.com) Coolpix 5000 digital camera, a 180° fisheye lens with step-down ring adapter, the iPIX Rotator with attached compass, and a full-height tripod. The company also sells upgrade kits (fisheye lens, tripod, iPIX Rotator, and so forth) to customers that already have a Nikon D1, D1X, or Coolpix 885, 990, or 5000; or Canon (www.canon.com) EOS D30 or D60 digital camera. Although kits do not include a GPS receiver, the iPIX Mapping System is compatible with popular GPS units from Garmin (www.garmin.com), Thales Navigation Magellan(www.magellangps.com), Brunton (www.brunton.com), and Silva (www.silva.se); the Casio (www.casio.com) GPS watch; and Trimble (www.trimble.com) GPS receivers supporting Trimble's GPS Pathfinder Office software. The iPIX Mapping System software comprises iPIX's GeoBuilder and MediaMapper from Red Hen Systems (www.redhensystem.com). (Red Hen and iPIX formed a partnership to create the iPIX Mapping System by combining their technologies.) The software package requires an Intel (www.intel.com) Pentium III or better processor, Microsoft (www.microsoft.com) Windows 98, NT, 2000, or XP; 64 MB of RAM, and 24 MB of hard disk space. For our test, we installed the mapping system software on a Pentium-4 class PC with 1 GB of RAM and running Windows 2000. For image capture and GPS, we used our existing Nikon Coolpix 990 (with iPIX upgrade kit) and Trimble GeoExplorer II. An annual license for the iPIX Mapping System costs $5,000.

We were specifically interested in the efficiencies of using the hardware components in the filed and how well the software integrated 360° imagery and GPS data on a map display.

For our evaluation, we choose to incorporate the system into field observations related to a disease ecology investigation related to Lyme disease in Illinois in which we are participating. Our plan was to create maps with linked imagery showing potential habitat areas for deer ticks, the primary vector for Lyme disease in the United States. Lyme disease, which was first observed in the United States in the mid 1970s near Lyme, Connecticut, infects about 16,000 people each year, mostly in the northeast and upper Midwest states (CDC 2003). Recent research that led to the development of spatial models of potential tick habitat in Illinois (see Guerra et al. 2002) guided our selection of a site for our test. The site we chose was a wooded area near the Sangamon River where no Lyme disease has yet been detected, but where the model suggested it might occur in the future.

Glossary

GML: GPS MediaLink

HTML: Hypertext markup language

USB: Universal serial bus

UTC: Coordinated Universal Time

Preparing

We started our work by putting together our equipment and loading the iPIX Mapping System software. The basic equipment included a digital camera and a GPS unit. We used our exist-

ing Nikon Coolpix 990 and Trimble GeoExplorer II. Additional hardware included a Nikon fisheye lens, a tripod, and the iPIX rotator— all provided as part of the Nikon Coolpix GPS Mapping System Kit upgrade package for the iPIX Mapping System.

Though fisheye lenses were originally used mostly in scientific and technical applications, they have become popular for special-effects photography. The lenses widen the image prospective to include peripheral views to top, bottom, and sides that are missed by a traditional lens. The iPIX rotator attaches between the tripod and the camera, so that one can shoot a photograph in one direction, then turn the camera exactly 180° to capture the opposing view. Our Coolpix 990 series readily adapted to the tripod, rotator, and fisheye lens.

The iPIX Mapping System software similarly loaded without difficulty on our office computer. The software comprises two primary components for two tasks. The iPIX developed GeoBuilder includes the tools to take two images shot at 180° opposition and stitch them together into an immersive whole. MediaMapper then provides the means to read the GPS points, link them to the iPIX image using the time stamp on both files, and map the data. Several additional products were also loaded automatically when we installed the software even though we had no license for them. The additional products included a program for downloading imagery from the digital camera into the computer and the iPIX Viewer, a browser plug-in for interacting with iPIX imagery on the Web [[**correct? If not what were the extra programs loaded and what did they do?**]]. The additional software made the initial setup a bit confusing but not overwhelming because we had to assess what was loaded on our computer and what the products did. Such information was not readily provided when installing the software.

Looking around

With our hardware and software preparation complete, we set out to the field with our GPS receiver and camera equipment to capture images of ground locations within the potential tick habitat areas. At the site, we turned on our GPS unit and started collecting data points. We only needed to create a single data directory under which to collect all the GPS data because MediaMapper synchs the GPS points and camera imagery according to time-stamp information.

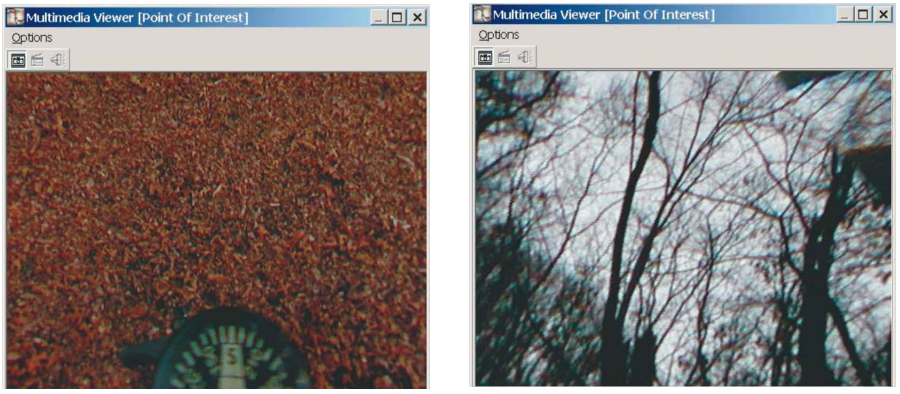

FIGURE 1a and 1b The iPIX Mapping System stitches together two 1808 image views to produce a 3608 image. 1a shows an image looking down with a view of the compass and 1b is the opposite view at the same location, looking up toward the sky.

While our GPS was documenting time and position, we took two hemispherical images 180° apart from one another. iPIX's rotator adapter has a lock divot which ensures that one takes two evenly rotated pictures. Another handy item was the compass located on the rotator which allowed us to orient ourselves to the direction the image was taken when reviewing it later.

After snapping an image, we stopped the GPS unit from streaming (you can leave it on if working in a small area), packed the camera and tripod, and proceeded to another location. The 32-MB memory card in our 3.2-megapixel camera allowed for approximately 20 exposures (10 immersion images) with the camera set to collect at a 2,048 X 1,536 resolution under "fine" compression.

Stiching images together

After collecting the data and back in the office, we connected the camera to a workstation and uploaded the imagery. Nikon cameras come with Nikon View software which will automatically recognize when an active camera is connected to a USB port. That software asked how we wanted to upload the imagery and prompted us to select the storage directory and files to upload. It also let us view a slideshow to weed out any bad shots.

With the imagery imported, we opened the iPIX Mapping System software, which launched us into the GeoBuilder version 1.0 program. With GeoBuilder, stitching together the hemispherical snapshots to create immersive spherical images simply involved selecting and loading groups of hemispherical shots and telling the software to stitch the imagery. We could then pan and zoom the resulting images in virtually three dimensions (see Figure 1).

Merging GPS. Our next step was to merge imagery with the respective location in geographical space. To do this, we ported the Trimble GPS data to MediaMapper's GPS MediaLink (GML) format. (We found the choice of the "GML" abbreviation unfortunate, given the development of the geography markup language [GML] by the Open GIS Consortium. It took some research to conclude that there is no connection between the two GMLs.) The transfer involved first loading the GPS data into Trimble's GPS Pathfinder Office software and subsequently exporting the point files in Red Hen's GML format. Importantly, by first loading the data into Pathfinder Office, users can perform differential correction and group points or data definitions before exporting GPS positions to MediaMapper. Also, it's worthwhile noting that the MediaMapper export option is available automatically if Pathfinder Office was already installed when loading the iPIX Mapping System. If loading Pathfinder Office after installing the iPIX Mapping System software, users will need to run a utility which registers the MediaMapper format.

With the GPS data exported in the

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GML format, we then loaded the GPS data concurrently with the immersive imagery into MediaMapper. MediaMapper then evaluates the timestamps from the imagery again the GPS positional records to properly associate the pictures with true geographic locations. To perform this synchronization, though we had to enable MediaMapper to calibrate the time shift between the camera's clock and the universal timestamp of the GPS data. This involved, following iPIX's documentation, loading the current UTC from http://nist.time.gov and taking a picture of the browser display with the camera (this should be done shortly after completing field work). Thus, when we loaded the imagery into MediaMapper, we entered the time displayed by the atomic clock service Web site in that picture and MediaMapper compared that time to the camera's time stamp to gauge the clock drift of the digital camera for all the imagery we imported.

Pictures on the map

After MediaMapper automatically associates the correct GPS locations with the respective immersive image files via the timestamps, the software then loads the imagery into its view frame as hyperlinked points. In the map view of MediaMapper, users can then manipulate the symbology of the link points, GPS points, and load base layers to give maps appropriate context. MediaMapper readily accepts in ESRI and MapInfo GIS files, as well as raster imagery in WWF, BMP, JPEG, GIF, TIF, PNG and PSD formats. For our project, we were able to import a GIS map of tick habitat into MediaMapper (see Figure 2). Unfortunately, we could not bring it in as a grid file, and had to first create and export a vector file of the basemap in our GIS.

To share maps created with the iPIX Mapping System, users can export data as an HTML page. MediaMapper includes some useful tools to manipulate the visual appeal of HTML output as well as builds in links that provide those viewing the HTML maps with the necessary iPIX Viewer, the browser plug-in for interacting with the immersive imagery. The HTML output looks much like any Internet map service site: a tiered table-of-contents, layer toggles, a map view frame, and areas for titles, acknowledgements, and further links.

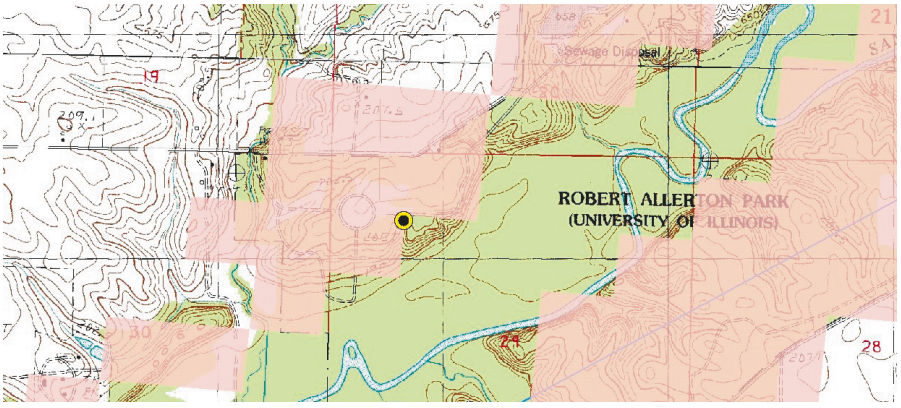

FIGURE 2 Potential tick habitat at the field site near the Sangamon River, Illinois. The yellow circle shows a hyperlinked GPS point with an attached iPIX image.

MediaMapper also exports data in ESRI, MapInfo, and the image formats aforementioned. When exporting to ESRI and MapInfo, however, the program builds image hyperlinks into an attribute field. Thus, to recreate hyperlinks within the GIS program's interface, one must construct a means for the GIS to read the appropriate field data and load an iPIX Viewer with a click execution.

An immersive view

Overall, we enjoyed using the iPIX Mapping System, and it performed as promised. It took some practice to know what camera settings we needed to use — on our first try, we didn't set the camera focus to infinity and the images were not optimal. In addition, the number of unlicensed options in the software bundle took some time to work through and could probably be eliminated with more focused product packaging. But once we have learned the system, it was an efficient environment for creating media-rich maps. We particularly noted a time-savings resulting from the reduction in the number of images needed to document a given area.

On the downside, the cost of the software was an issue for us. The $5,000 annual license for the iPIX Mapping System, plus upgraded camera equipment, can be hard to justify. One would need to make a critical assessment of just how much the immersive view would add to field work for a particular application. Also, if a user has already invested in complete GIS, he or she may not usually require the general mapping features of MediaMapper. Incorporating iPIX Imagery into a mature GIS environment, though, could be cumbersome, requiring some time to mesh the different software architectures and methodologies together. But if developing a Web GIS, in terms of time invested, the delivery of iPIX's media-rich immersive layers is most feasibly accomplished using the HTML export option in MediaMapper. Thus, building Web-mapping services is the system's most significant strength.

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