Web GIS Application to Update and Maintain Recreational Trails Database

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ABSTRACT

The Florida Department of Environmental Protection's Office of Greenways and Trails (OGT) has been working to establish a statewide system of greenways and trails. The University of Florida GeoPlan Center, a GIS teaching and research center, has been assisting OGT with technical support to develop these plans.

The UF GeoPlan Center has developed an interactive website to collect information about existing trails and trailheads. This website allows for online digitizing and uploads of complete GIS datasets to support the update of Florida's existing trails dataset and the creation of an existing trailheads dataset. This web application, which utilizes ArcIMS and ArcSDE technologies, displays essential GIS data layers required to support trail data collection.

This web application will assist the collection of comprehensive trails and trailheads information and the development of a standardized trails database. The resulting trails information will support OGT's vision of creating a statewide system of greenways and trails.

INTRODUCTION

The Florida Department of Environmental Protection's (FDEP) Office of Greenways and Trails (OGT) has been working with numerous organizations for years to establish a statewide system of greenways and trails. The evolution of these efforts resulted in a report entitled '*Connecting Florida's Communities with Greenways and Trails: The Five Year Implementation Plan for the Florida Greenways and Trails System* (DEP and FGCC 1998). The implementation plan contains a series of recommendations and specific strategies for building this statewide greenways system.

The University of Florida GeoPlan Center has been under contract with the FDEP since 1995, assisting the agency with the development of plans, analyses, data collection, GIS support, public meetings and presentations to the Florida Greenways Commission and the Florida Greenways and Trails Council. The UF GeoPlan Center is a GIS teaching and research center within the Department of Urban and Regional Planning.

The University of Florida assisted with the initial 1998 Greenways Plan by developing a GIS model of the ecological and recreational greenways network. The 1998 greenways plan was accompanied by a map series showing potential recreational trails derived from University of Florida GIS model results and public comments. These opportunities maps identified potential areas within the state for inclusion in the statewide greenways system.

In 2003, the University of Florida assisted in creating the Florida Trails website, which was developed to facilitate the first update of the Recreational Trails Opportunities Map Series by summer 2004. The website provided a means to collect and update trail information, public comment from individuals and organizations throughout Florida, and assisted in the prioritization of opportunity segments for use in decisions about grant allocations.

Current Scope of Work

During 2004-2005, the Florida Trails website was expanded to support the continuous collection and update of the Florida Existing Trails GIS dataset. The interactive website offers various methods for users to submit information about existing recreational trails and trailheads, and displays essential GIS data layers required to support trail data collection.

Primary features of the interactive Florida Trails website:

- Uses ArcIMS to display GIS layers of the most recent existing recreational trails and trailheads, Trail Opportunities, and basemaps;
- Allows users to upload shapefiles of existing trails or trailheads;
- Allows users to digitize existing trail segments or trailhead points onscreen;
- Offers free download of most recent existing trails, trailheads, and opportunities maps.

The web application offers a comprehensive and consistent method of collecting trails information, which subsequently supports the development of a standardized trails database. The resulting trails information assists FDEP's vision of creating a statewide network of greenways and trails. By first developing a standardized inventory of existing recreational trails in State of Florida, gaps and needed links in the statewide trails system can then be more easily identified.

The web application utilizes ESRI's Internet Mapping service (ArcIMS), ESRI's Spatial Data Server (ArcSDE) and Oracle relational database management system (RDBMS). HTML (Hyper Text Markup Language), JSP (Java Server Pages), Java Script, ArcSDE JAVA API, PL/ SQL, and XML were used to develop the website components.

This paper describes the technical components and structure of the Florida Trails website and its role in assisting FDEP with the statewide greenways planning process.

System Configuration

There are two servers for the Florida Trails website. The RDBMS server stores and serves the GIS data using Oracle RDMBS and ArcSDE software. The ArcIMS/ Web server hosts the html pages, as well as handles ArcIMS requests.

RDBMS Server:
      Red Hat Linux Advanced Server, Release 2.1AS
      Oracle 9i
      ArcSDE 9.0

ArcIMS/ Web Server:
        Red Hat Enterprise Linux ES, Release 3
        Apache 2.0.46
        Jakarta Tomcat 4.1.30
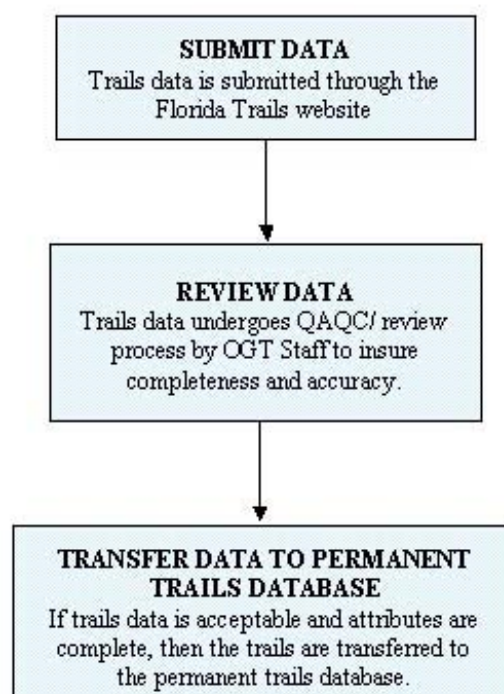   ArcIMS 9.0

COMPONENTS OF FLORIDA TRAILS WEBSITE

There are three primary GIS modules comprising the Florida Trails Website:

- *Public Map Viewer:* Public-access map viewer for GIS Trails and trails-related layers
- *Data Input Modules:* Allows users to submit existing trails and trailheads data. There are two methods available for submitting data. Shapefiles of trails data can be uploaded through the Upload Utility. Or trails data can be drawn online using the Digitize Utility.
- *Data Review Modules:* Allows users and OGT Staff to review spatial features and attributes of recently submitted trails and trailheads before the new features are accepted into the permanent trails database.

It should be noted that the *trailheads* layer is a new data layer that is being created through the data input components of the Florida Trails website. However, for simplicity, the existing recreational trails data will only be referred to when describing the data collection and update process as detailed in this paper.

The website was designed to give users a flexible method of submitting trails data and to give OGT Staff a comprehensive means of reviewing the recently submitted trails data. The website was built around the following basic process for reviewing trails data:

Figure 1. Basic Review Process for Trails Data

SUBMIT DATA
Trails data is submitted through the
Florida Trails website

REVIEW DATA
Trails data undergoes QAQC/ review
process by OGT Staff to insure
completeness and accuracy.

**TRANSFER DATA TO PERMANENT
TRAILS DATABASE**
If trails data is acceptable and attributes are
complete, then the trails are transferred to
the permanent trails database.

PUBLIC MAP VIEWER

The ArcIMS Map Viewer, which is open to the public, displays trails opportunities layers, prioritized trails opportunities layers, the most recent existing recreational trails layers, and other layers for orientation such as roads, water features, county boundaries, conservation areas, points of interest, aerial photographs, and digital orthophoto quarter quads (DOQQs).

The ArcIMS site displays GIS layers as ArcSDE layers, which are stored in an Oracle RDBMS. Users have access to basic map tools (pan, zoom, identify, query, select, measure, etc) with which they can navigate and identify trails.

Figure 2. Florida Trails Public Access Map Viewer

DATA INPUT MODULES

The two data input modules, the Digitize Utility and Upload Utility, offer users multiple options for submitting existing recreational trails data. Both options require a login and password to ensure that only authorized users submit data.

Trails Digitize Utility

The Digitize Utility consists of an ArcIMS interactive map interface through which users can digitize or draw trail segments on the map, and a JSP form to collect attribute information.

Figure 3. Trails Digitize Utility – Map Interface
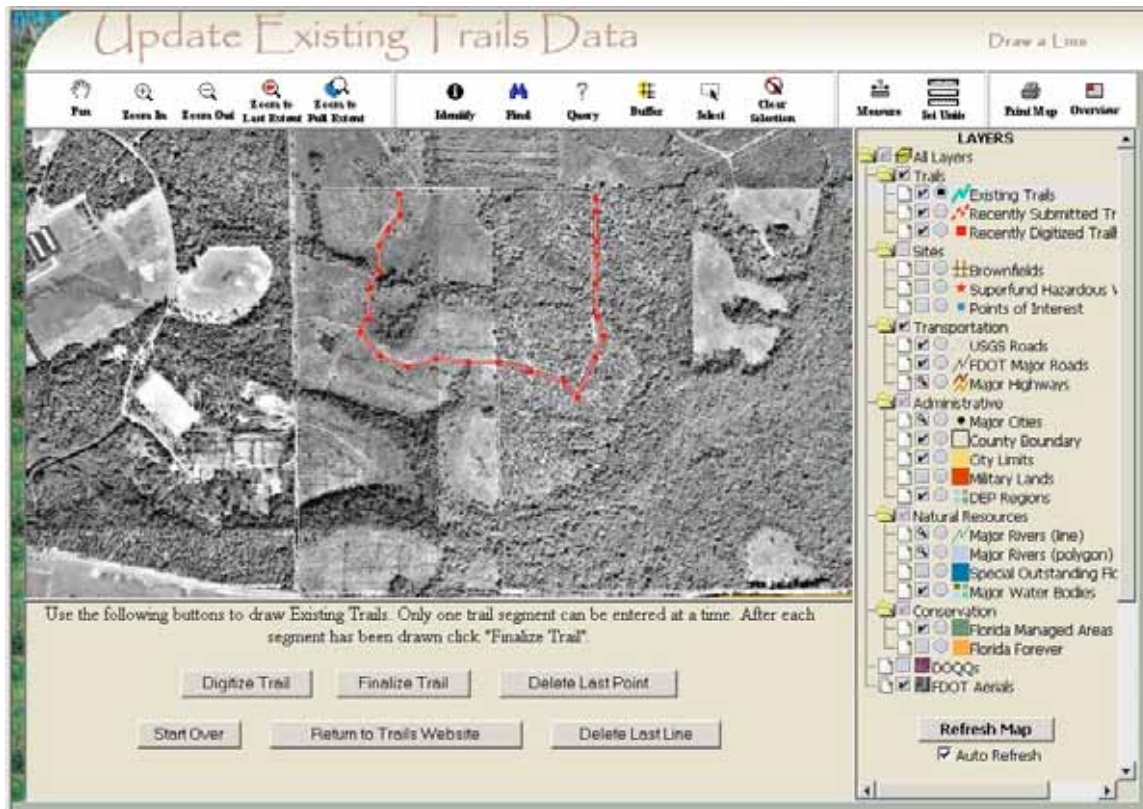
To add a trail, a user would first click 'Digitize Trail' and then draw a trail segment on the map (one segment at a time). The x,y coordinates for each point placed by the user are first collected using custom-made JavaScript functions and then are inserted into an Oracle table via a JSP script. On the RDBMS server, these x,y coordinates are converted into a segment and stored in the SDE database using the JAVA API.

After the trail segment has been drawn, the user must click 'Finalize Trail' which opens a JSP form through which they must enter the required attributes about the trail segment. If the user does not complete the attribute form, then the trail is not accepted into the permanent trails database.

Users can only submit one trail segment at a time. A trail *segment* is defined as an entire trail or portion thereof whose characteristics are consistent. For example, every segment should have the same surface for its entire length. And every segment should be designated with the same trail uses (e.g. Hiking, biking, equestrian) for its entire length.

Figure 4. Trails Digitize Utility – Example Attribute Form

Trail/ Trailheads Upload Utility

The upload utility allows users to upload shapefiles of existing trails. The upload utility form was written in JSP. To insure standardization of trail attributes, users are asked to include a specific set of attributes with the shapefile. Users have two options for including these attributes with the submitted trails data:

1. Add the required attributes to the shapefile before upload
2. Submit a shapefile without all the required attributes, and later return to the trails website to enter attributes through an online form. If users do not return to the website to enter the attributes, then the trail segments or trailhead points will not be included in the permanent trails databases.

After a shapefile is submitted to the website, its spatial features and any attributes are inserted into a temporary ArcSDE layer in the database. Next, the data is checked to see if the required attributes have been filled out. If the attributes are complete, then an automatic email is sent to OGT Staff to review the new trail segments or trailheads. OGT Staff then reviews the segments or trailheads, and if they deem acceptable, they are flagged for inclusion into the permanent trails database. The OGT Review Interface is

used by OGT Staff to review submitted trails and trailheads. (See next section – Data Review Components, OGT Review Interface).

If the attributes for an uploaded shapefile are not complete, then the user is emailed and asked to return to the trails website to enter the attribute information. The User Review Interface is then used for entering additional attribute information for previously submitted trail segments or trailheads (See next section – Data Review Components, User Review Interface).

DATA REVIEW MODULES

There are two data review components included in the website – the OGT Review Interface and the User Review Interface.

OGT Review Interface

The OGT Review Interface allows the OGT Staff to review all trail segments that are submitted through the trails website. OGT Staff is responsible for quality assurance/ quality control of the data submitted.

After trail segments are submitted and the attributes are complete, OGT staff receives an email about trails that are in need of review. OGT Staff then logs on to the trails website to review recently submitted trails. The Existing Trails Review Queue page lists the trails that are in need of review.

Figure 5. Existing Trails Review Queue for reviewing recently submitted trail segments

Once staff selects a trail from the Review Queue, and chooses 'Review', the OGT Review Map Interface opens. Trails that need review are listed in the bottom frame of the viewer. OGT Staff can zoom to trail needing review and check the spatial location of the trail segment. OGT Staff can also review and edit the attributes of the trail segment.

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Once OGT Staff has reviewed the trail segment and corresponding attributes, they change the *status* of the trail segment depending on their review. The status is changed in the Review Trail Attributes Form. There are five status options:

Needs Review: OGT Staff needs to review this trail segment. This is the default status of a trail segment that has been submitted.

Pending: OGT Staff has begun the review process, but the segment is still pending approval.

Accepted: OGT Staff has reviewed the trail segment and accepted it for inclusion to permanent trails database.

Not Accepted: OGT Staff has reviewed the trail segment and determined it not acceptable for trails database.

Send Back to User (Needs More Information): OGT Staff has reviewed the trail segment and determined it needs more information for attributes. If this status is chosen, the user is sent an automatic email and asked to return to the website to enter additional information. In the Review Trail Attributes Form, OGT Staff can write comments to the user.

Figure 6. OGT Review Map Interface for reviewing recently submitted trails
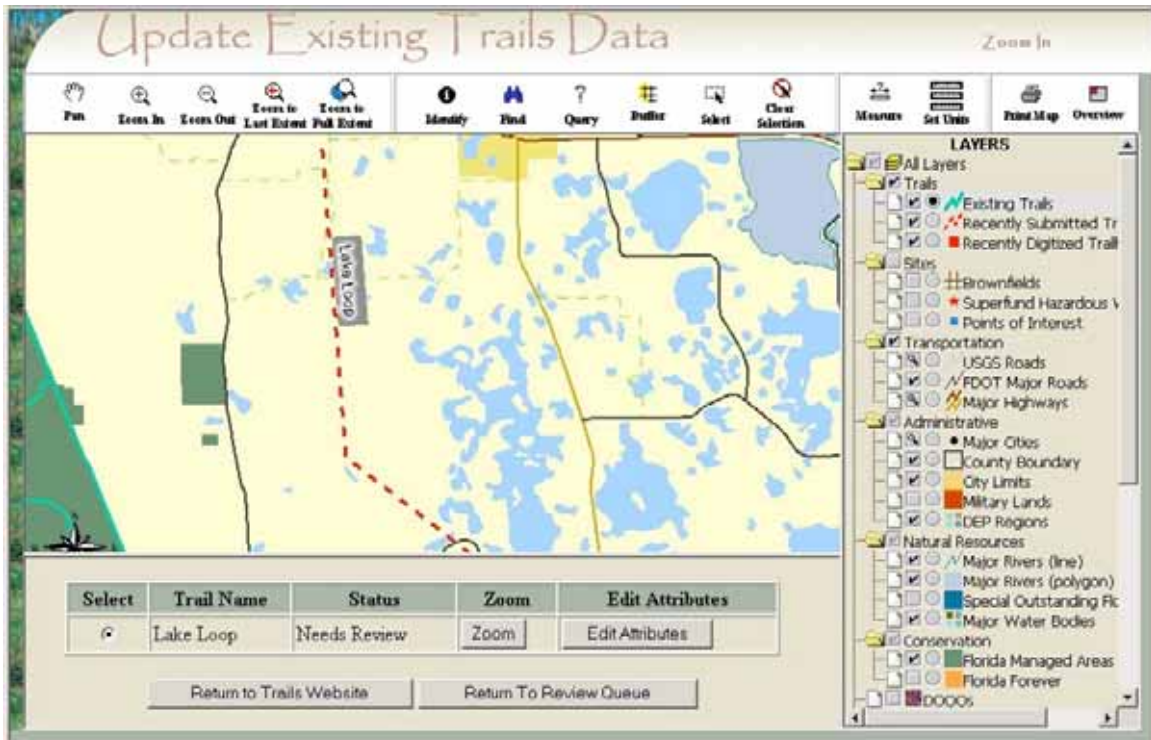
Figure 7. OGT Review Trail Attribute Form for reviewing attribute information of recently submitted trails

User Review Interface

The User Review Interface allows users to enter additional information about trails or trailheads that have been previously submitted. This interface is used when (1) a user submits a shapefile without all the required attributes; or (2) a user digitizes trails data online, and OGT Staff decides upon review that more information is needed about the trail.

The user is sent an email and asked to return to the trails website to enter the attribute information. When the user returns to the site, the User Trails Review Queue page lists the trail segments that still need attributes. The user can only add/ edit attributes for trail segments that they submitted.

Figure 8. User Trail Review Queue for users to enter additional trail information

The user can select a trail, and click 'Review', which opens up an interactive ArcIMS Map Viewer, from which they can view the submitted trails and add attributes using an online form. Once all attributes are complete, the status of the trail segments returns to 'Needs Review' and OGT Staff once again are prompted to review the trail to check its completeness and accuracy.
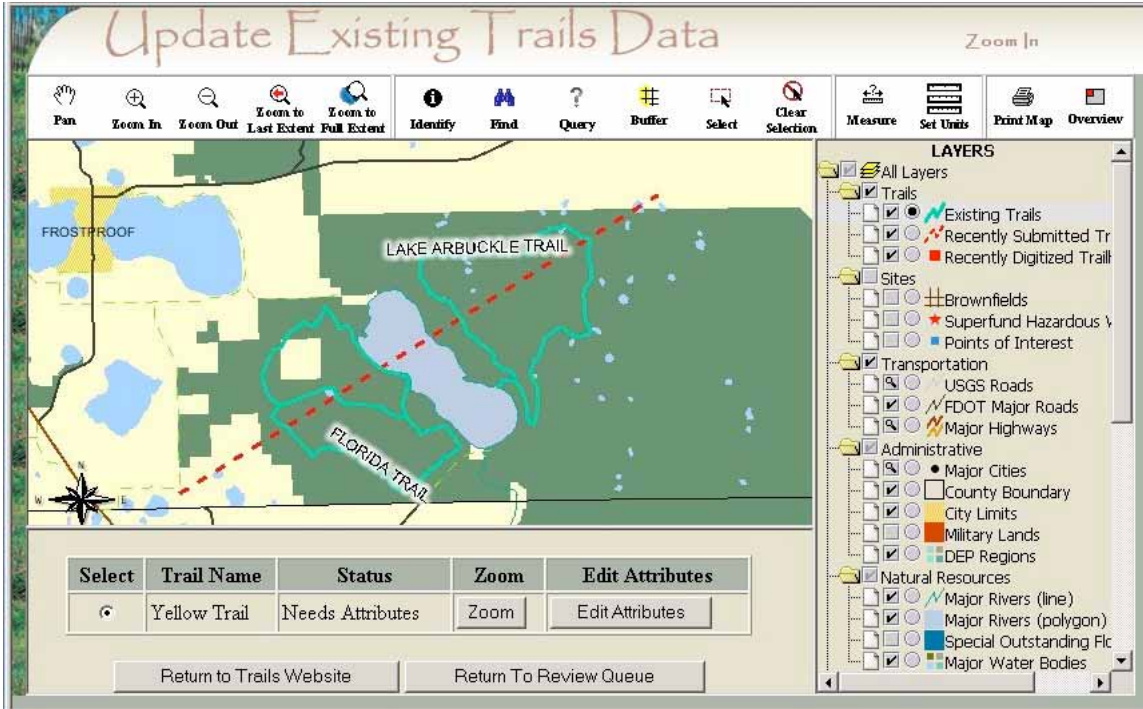
Figure 9. User Review Map Interface

Figure 10. User Review Form for adding trails attributes.

Conclusions

Compilation and standardization of Florida trails data from a multitude of organizations around the state is a time-consuming task. The interactive Florida Trails website offers flexible methods for users to submit trails data from their personal computer and insures collection of the trails data in a consistent and comprehensive manner. Furthermore, the website allows OGT Staff to comprehensively review and edit trails data to ensure fitness of the data before inclusion to the permanent trails database.

By facilitating this first-step inventory process and creating a standardized trails database, the Florida Trails website builds a foundation on which OGT Staff are better equipped to make planning decisions for the Statewide Greenways and Trails Planning process.

Acknowledgements

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