

Mobile Geographic Information System (GIS) for Forest Conservation and Surveillance

by

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Abstract

Since most GIS software migrated from proprietary data to mainstream database formats like Relational Database Management System (RDBMS) and programming languages to Microsoft .Net, Java etc., we are witnessing rapid advancements in GIS technology, where by users realizing the importance and advantages of storing enterprise-level data, instead of storing information in conventional file-based systems. Storing data in file-based system is not only redundant, but holistic view of the entire data is not always available to Senior Management in order to monitor the status from a high-level point of view and subsequent prompt decision making. In the recent fast grown Mobile Technology environment, capturing, storing and analyzing spatial data using mobile devices is no more a dream!

In most forests, areas to be patrolled on a day-to-day basis are decided at the Range-level, as well as subordinate-levels of Beat Guards and Foresters. The State-level and Senior-level Officers will not have instantaneous holistic view of the areas being patrolled versus areas not being patrolled over certain periods of time. Due to this limitation, Senior-level Officers cannot make any real-time interventions in forest monitoring on a day-to-day basis. Recent technological advancements incorporating Mobile-based GIS will help the Forest Departments to resolve issues through spatially enabled decision making. This article describes how Mobile GIS can be used in forest-governance through monitoring, incident management and analyzing of geospatial data.

Keywords: Forest, GIS, Mobile

1. Background

In forest areas, communicating any information instantaneously to the senior-level officers about any incident (such as encroachments, illegal tree-cuttings, injury to animals) is a difficult task because of unavailability of landmarks unlike in developed urban areas. Rescue teams also need to follow the conventional methods to reach the place. Sometimes delay in response for such events may result loss of wildlife and damage to habitat.

Following are some of the problems that Forest Departments usually deal with:

- No centralized tool to monitor staff movement inside forest,
- Lack of records about patrolled and unpatrolled areas,
- Unable to communicate to the staff in the field instantaneously,
- Conventional method to manage the events, plantation and incidents, and
- Decentralized data maintenance.

2. Mobile GIS in Forestry

In this novel system, all forest personnel would be equipped with Mobile Devices for transmission of voice, data and location information to the Control Center. Transmission of these coordinates to the central server enables the senior-level offices to monitor the staging of forest personnel from a web-based application that helps to visualize a real-time patrolling coverage at the server-end. Such knowledge would help to redirect the patrolling staff to new positions of unfrequented areas. In situations of emergency, reinforcements can be called in and/or rushed with a better understanding of field situation. Manual transmission of events (i.e. Forest Fire, Encroachments, and Sighting of Injured Animal) constitutes a very important functionality, since the generated dataset would enable better formulation of specific management interventions (Figure 1).



Figure 1: Flow of GIS Data in Forest Conservation and surveillance.

By integrating the real-time GIS data generated from mobile devices with the Management Information System (MIS) application (Figure 2), it is possible to generate trends and maps relating to offences and any other desired parameters that helps in formulating suitable management interventions. With this Mobile-enabled Enterprise GIS System for forest departments, the following advantages can be clearly perceived:

- Monitoring and tracking of forest staff and events in the forest,
- Geospatial intelligence for prompt decision making,
- Integration with Short Message Service (SMS) gateway, and
- Integration with MIS system.



Figure 2: Components of Enterprise Solution.

3. Mobile GIS Application

A custom mobile application is developed for Windows Mobile and installed in Personal Digital Assistant (PDA)/Smart Phone (Figure 3), which enables the field staff to view patrol areas defined by their senior officers. The mobile device will send its position to the server located at Control Center on regular intervals, with or without any notice of its user based on predefined settings. Field staff can view the areas to be patrolled along with their own positions in the mobile application that displays interactive maps. This application allows users to record the events (i.e. Forest Fire, Animal Sighting, Sighting of Injured Animal, Illegal Tree Cutting, Poaching), which will be synchronized to the server immediately in case General Packet Radio Service (GPRS) Network is available, nevertheless it stores information in the local database within the mobile device in case GPRS Network is not available at that point of time. This data will be synchronized to the server, as early as the user reaches to any available network area.

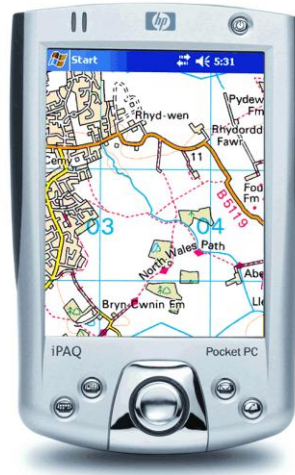


Figure 3: Picture of a PDA Device (Source: Fugawi)

In addition to the above features of this innovative application, field staff can also query the events that have occurred for a given duration using a mobile device. Managing GIS data such as creation/editing/deletion of the features using the mobile application allows a field staff to manage field-based recording (such as Locations of Plantation, Landmarks etc.) to be reflected in the database shortly after validation done by a senior staff in the central forest office.

4. Web-based Application

The associated web-based application allows the senior-level officers to monitor the movement of forest personnel and perceive those events that are recorded by field-staff, while using the Central Control Room facility. Based on the instantaneous patrolling coverage by individual field-staff, senior-level officers can send the instructions to cover the unpatrolled areas using Voice Calls and/or SMS to mobile devices. Further, in case of occurrences of emergency events, office-based staff can identify the nearest Rescue Team and instruct the same to reach the incident location following the closest route generated using GIS.

Moreover, office-based staff can analyze the patterns of events that have occurred in the forest to devise suitable action plans in order to restrict and mitigate illegal activities and encroachments, including unlawful tree cutting, hunting etc. Due to easy availability of information in a centralized database, Circle and Division-level Officers can also monitor the events, thus can communicate with the adjacent Range-officers in case there is any cross-boundary operations need to be carried out. This web-based GIS application has the following listed features:

- Monitoring of the forest personnel and significant events,

- Capability to transmit Voice Calls/SMS as necessary,
- Analyze the trends in illegal tree-cutting, forest fire, animal movement pattern etc.,
- Editing and authorizing of GIS data,
- Identification of the forest personnel and closest rescue team based on given incidence location, and
- Custom reports generation with printing facility.

5. Integration of Mobile-based and Web-based Application

The web-based application and mobile application are tightly integrated to communicate the information in both ways. In addition to this, the web-based application is also integrated with other MIS(s) for better management of the infrastructure within the forest department and its resources (Figure 4).

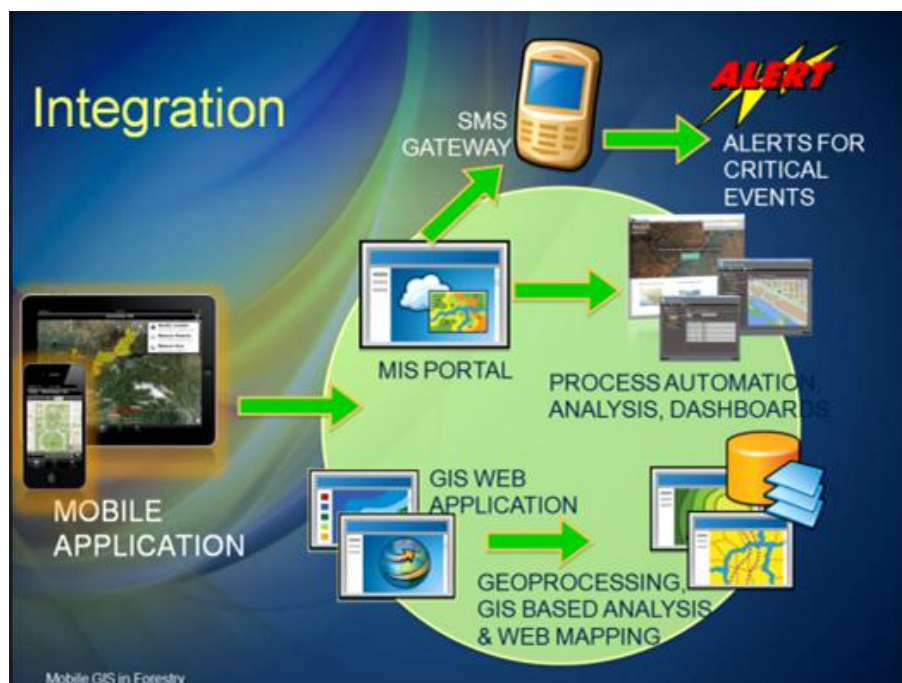


Figure 4: High-level integration of the Mobile Application with other Systems.

6. Conclusion

This mobile based solution is definitely improving the forest protection and surveillance activities carried out by the forest department, thereby reducing the response time in case of emergency events. Due to the utilization of an enterprise-level database for GIS, this system

enables the senior-level officers leveraging the geospatial intelligence to make impromptu decisions.

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Brief Biography:



I [Surya Chandra Rao Lanka] have been working as a Project Manager for NIIT GIS Ltd (ESRI India) with cross functional experience of 15 years in CAD/GIS Application Development, Project Management and Quality Management areas. I had successfully executed CAD, GIS and Marine GIS projects in desktop, web and Mobile technologies for various national and international clients.

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