Building a Map-based Web Platform for Aggregating User Content

Chinmay Bokil, Viraj Kanwade, Subha Ramakrishnan, Shriniwas Kulkarni, (GSLAB, Pune[1]),
R. Prabhakar (Strand Life Sciences, Bangalore[2] and ATREE, Bangalore[3])

Abstract

Over the last decade, mapping technologies and geographical visualization have developed at rapid pace. With the availability of high-resolution satellite images, we have seen the emergence of popular and freely available geographical visualization sites on the Internet, like maps.yahoo.com and maps.google.com. Along with this, the availability of cheap location enabled mobile devices has the potential of unleashing a whole host of location-based services. Versatile map-based web applications feeding on such technologies are just emerging on the global market and have tremendous potential in the world market and in growing and expanding economies like India.

Over the last six months, we have developed a map-based web application platform that is generic and that can be used for a variety of purposes. The platform provides rich geographical visualization using the available Internet map servers like http://maps.google.com and maps.yahoo.com. It provides the ability to overlay custom geographical content on the base maps. And importantly, it has the ability for aggregating user content. Thus, any user will be able to locate an area and upload any geo-referenced location-based information to the Internet. User contributed content can then be aggregated and served on the Internet. The platform has a structure of roles that allows user content, content validation and content aggregation.

[1] http://www.gslab.com. GSLAB, Pune
[2] http://www.strandls.com. Strand Life Sciences, Bangalore.
[3] http://www.atree.org. Ashoka Trust for Research in Ecology and the Environment, Bangalore.

The platform has been built with a robust architecture of a back-end PostGIS database integrated with various open source and custom components. The platform still in rapid development is highly scalable and customizable.

The platform has been developed over the last six months (June to December) for the India Biodiversity Portal, under the initiative of the National Knowledge Commission. The Portal was formally launched to the public on 15th December 2008 (http://www.indiabiodiversity.org). The India Biodiversity Portal is a map-based wiki focused on gathering, aggregating and serving biodiversity information on the Indian subcontinent. It has been populated with over a 100 layers of custom data on biodiversity and conservation. These provide the basal layers on which the portal intends to solicit participation and aggregate large-scale widely distributed information on biodiversity and conservation.
All biodiversity and conservation information is, by definition, spatial in nature, located in a particular geography. Thus, map-based technologies provide an effective platform for sharing and analyzing biodiversity.

We are working on the principle that biodiversity informatics should harness collective intelligence, exploit the long tail of information, and aggregate the wisdom of the crowd. We believe, map-based systems working on the principle of the wiki could evoke democratic participative action. We hope to expand biodiversity knowledge by this web-based collaborative network which solicits broad-based participation from people, government, research institutions and conservation NGOs, interconnects existing databases and makes them readily accessible by all stakeholders interactively.

1. Introduction

Over the last decade, mapping technologies and geographical visualization have developed at rapid pace. With the availability of high-resolution satellite images, we have seen the emergence of popular and freely available geographical visualization sites on the Internet, like maps.yahoo.com and maps.google.com. Along with this, the availability of cheap location

enabled mobile devices has the potential of unleashing a whole host of location-based services. Versatile map-based web applications feeding on such technologies are just emerging on the global market and have tremendous potential in the world market and in growing and expanding economies like India.

We have developed a map-based web application platform that is generic and that can be used for a variety of purposes. The platform provides rich geographical visualization using the available Internet map servers like maps.google.com and maps.yahoo.com. It provides the ability to overlay custom geographical content on the base maps. And importantly, it has the ability for aggregating user content. Thus, any user will be able to locate an area and upload any geo-referenced location-based information to the Internet. User contributed content can then be aggregated and served on the Internet. The platform has a structure of roles that allows user content, content validation and content aggregation.

The portal was officially launched on 15th December 2008[4]. The portal http://www.indiabiodiversity.org launch evoked considerable response from the invited participants, the press, and from the consortium of partners who had contributed to the development of the portal. It was clear this was a first step in the direction that would involve citizens and a wide spectrum of civil society in biodiversity and conservation and could generate and aggregate very rich data and valuable information on biodiversity and conservation of the country. Its map-based nature and its emphasis on public participation are its unique strengths. At the launch it was made clear that this was a beta launch, and this is work in progress and we are committed to developing and deploying additional features on a regular and monthly basis.

[4] The portal http://www.indiabiodiversity.org was launched by Sam Pithroda on 15th December 2008 at the Infosys Campus in Bangalore. The portal evoked large response from the public and press and there was large-scale appreciation of the idea of user-generated content for biodiversity informatics.

2. Geographical Visualization

Remote sensing technologies are potent tools to monitor the environment and map the surface of the world. The LANDSAT system put up in the 1970s by the NASA and the U.S. Geological Survey has helped monitor the earth resources[5]. These images are now freely available on the internet and are a valuable resource to study changes in the environment.[6] Other earth observation systems like SPOT and IRS have been gathering images of the earth's surfaces since the 19980s. These were mainly multi-spectral images in the electro-magnetic spectrum, and needed to be processed and interpreted for understanding and analysis. Since early 2000, government satellite systems as well as private companies[7] have been launching high-resolution satellites in the visual spectral range for earth observation. These images can be directly viewed and interpreted by the human eye. They are like photographs of the earth's surface and are amenable to direct geographical visualization. The meter and sub-meter resolution of these images, further allows users to identify and pick features that can be mapped.

During the February 2000, the Shuttle Radar Topographic Mission ran a program to get a 3-D view of the earth's surface at a 30 meter resolution. These were them processed and are now freely available at SRTM data with resolutions of 30 m and 90 meters. These allow a 3D view of the earth's surface.[8]

With the availability of high-resolution satellite images and a whole earth topography, Internet companies like Yahoo, Google and Microsoft launched sites that gathered and compiled these

[5] http://en.wikipedia.org/wiki/Landsat gives an overview of the LANDSAT system. The LANDSAT system was a government system of satellites used for monitoring earth's resources.
[6] Since the 1990s, these images are freely available over the internet. This is a useful resource to study changes in the environment. http://landsat.gsfc.nasa.gov/
[7] http://www.digitalglobe.com/ Digital Globe is one of the companies that launched high-resolution satellites for earth observation. The resolution of these images is 60 cms. New satellites are being planned that will provide panchromatic and multi-spectral images at resolutions of 46 cms, and with better spatial accuracy.
[8] SRTM (http://www2.jpl.nasa.gov/srtm/) data is available freely. Country and site specific processed data is available from various sources like http://www2.jpl.nasa.gov/srtm/cbanddataproducts.html and http://srtm.csi.cgiar.org/.

high-resolution images and served them on the Internet[9]. These sites provide rich geographical visualization of areas of the earth's surface with shaded relief, oblique views, various zoom levels and virtual fly-thoughts. The easy and free availability of such sites on the Internet with attractive user interfaces has liberated geography, map-making, and annotating surfaces of the earth like never before. This proves is still unfolding in the current decade with large and rapid advances in geographical visualization and location technologies. Thus users with a simple internet connection can zoom into an area locate themselves, virtually go through their immediate geography and identify places and locations they are familiar with.

3. Leveraging Web 2.0 technologies for a map portal

Many conventional map servers in various domains deploy and serve spatial data over the Internet.[10, 11] These conventional technologies provide limited functionality in that they query and render already available data as a map over the Internet. They have sophisticated rendering capabilities and can zoom, pan, layer and render the map on a canvas. However, all internet map servers are synchronous;[12] heavy on the server; slow in rendering; and, provide very limited means to effectively interact with the data behind the servers. Further, all vendor-supported web-services do not provide easy exchange of spatial data. Thus current map-based

[9] http://maps.google.com
http://maps.yahoo.com
http://maps.live.com/

[10] Many conservation sites serve map data over the Internet.
http://www.unep-wcmc.org/imaps/IMapS_help.htm
http://www.ecoinfoindia.org/
http://www.conservationmaps.org/index.jsp
http://plasma.nationalgeographic.com/mapmachine/conservationmaps.html

[11] Various proprietary and open source web platforms are available for serving spatial data. Many map-based web servers use proprietary software like ESRI's Internet Map Server, MapQuest, Microsoft MapPoint, MapInfo, etc.
http://extranet.mapinfo.com/products/Overview.cfm?ProductID=1825
http://www.esri.com/software/internetmaps/index.html
http://mapserver.gis.umn.edu/

[12] The importance of asynchronous servers will be discussed in a later section. The synchronous nature of these servers means that the major task of creating and rendering the map will be done on the server. The client (the browser) submits a request to the server and waits patiently for the server to provide the map, meanwhile displaying an infinite hourglass to keep the users interested.

sites are centralized, not participative, server heavy, inflexible, and slow. Considering the importance of spatial data, the current scenario is inadequate in meeting the requirements of guiding policy and democratic participative action.

The word, Web 2.0, was first coined in a conference planning session by Dale Dougherty. Since then it has attracted a lot of attention and discussion in many blogs and public places. Although not clearly defined, it is born out of the realization that there was something "qualitatively different about today's web."[13] In the blogs and articles describing and theorizing on the Web 2.0, Google maps and geographical visualizations is extensively cited as a case in point for what the Web 2.0 represents.[14] It is thus important to look at the elements of Web 2.0 while designing a conservation monitoring map portal. We discuss the distinguishing elements of Web 2.0 and examine their appropriateness in leveraging these technologies in building a map portal.[15]

4. The Web as an Inclusive Platform

This is the age of creating web applications. The gap between the web and the desktop is closing and web-based applications can now be made to work like desktop applications. While the first wave of the web was based on the browser, the second wave is based on the browser being an interface between the desktop and complex applications running on the server. Take the example of Orkut, Gmail, Google Maps, Double Click, BitTorrent, Wikipedia and many more. These are based on complex applications running on servers, with the browser providing an interface to these applications.

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[13] Reacting to criticisms against the phrase, this article argues that there is something special about today's Internet.
http://radar.oreilly.com/archives/2005/08/not_20.html

[14] "Google Maps set the world on fire because of its simplicity, and the way Google Maps was implemented left the data for the taking, and hackers soon found ways to creatively re-use that data."

[15] The current section draws on the articles cited below, the hyperlinks from them and the discussions that these have generated. A good participative definition from collective wisdom is available on wikipedia.
http://en.wikipedia.org/wiki/Web_2
http://www.paulgraham.com/web20.html
http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

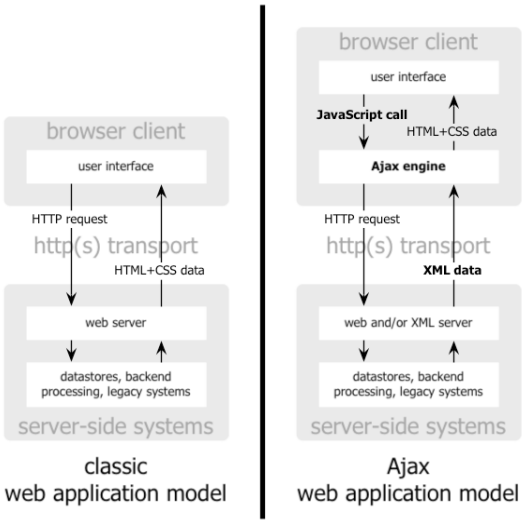

Figure 1

One of the main technologies that have made it possible for the web to be a platform is the Ajax recipe.[16] The Ajax recipe is a combination of technologies (Asynchronous java script and XML) coming together in meaningful ways, to provide sever-based applications on the desktop. They facilitate an asynchronous method of interacting with the server which provides a rich user experience for complex applications. The figure on the left outlines the Ajax model. Google Earth and Google Maps was the first full application to use the Ajax Engine. Since then there have spurt of activity on using the Ajax Engine and a whole new generation of software is being produced at break-neck speed.[17] The core of Ajax technologies are mature, stable and well understood. There are adequate trained personnel for the development and deployment of such applications. Development can be quick and since the deployment is server based, deployments can be easy and quick. The challenge is in the design of applications that will appropriately and effectively use Ajax for innovative expansion of the Web.

[16] The Ajax recipe is well articulated by the person who coined the word in the following article. Ajax came to be noticed in early 2005, when Google deployed Google Maps.
http://www.adaptivepath.com/publications/essays/archives/000385.php

[17] New applications, from inclusive instant messengers to rich user experience based applications are being developed and deployed at speeds never before seem in software development.
http://online.wsj.com/public/article/SB113098635587487074.html?mod=todays_free_feature
http://wwwl.meebo.com/index-en.html

GIS applications are heavy and visualization intensive. They have mainly been desktop applications providing very limited functionality for web-based manipulations. Current web-based map servers use the browser client and a synchronous mode of deployment that make it inadequate and unsatisfying to the end user. The Ajax recipe could be used advantageously to provide rich geographical visualization and interaction with the map portal.

5. The mantra of user generated content: Harnessing collective intelligence

Participatory web sites have been enormously successful at aggregating, sorting, filtering, classifying, and validating information. The conservation site should take full advantage of these strengths and develop them. The engine of harnessing collective wisdom is driven by three factors: the voluntary participation of users; a simple intuitive system of tags and categories; and, a participative system of rating and selection of content.

The Internet now abounds with millions of social and participative sites where users congregate to create content. The Wikipedia is the epitome of such collective wisdom. Wikipedia is already one of the top 100 web sites and is expected to become one of top ten very soon. And as they mature, better systems of self-organizing information, mechanisms of weeding out wrong, irrelevant and abusive content are quickly evolving. Structures for conflict resolution, peer reviewing and rating are available if users democratically choose to use them. The evolution and success of Wikipedia is a sociological study in itself.[18]

Along with harnessing collective intelligence a simple and intuitive systems of tags and categories have evolved that allow organizing the chaos of contributed data. Called folksonomy, [19] it is user generated taxonomy to categorize web pages and web content. At every site built on such collective participation, special provisions are made for creating and

[18] Wikipedia is an unimaginable social phenomenon where millions of users contribute to develop a widely used knowledge on any topic of interest.
http://meta.wikimedia.org/wiki/Wikipedia_sociology

[19] http://en.wikipedia.org/wiki/Folksonomy

using tags. Tags can also be used to enforce desired categories of information and guide and facilitate the evolution of information along certain axes.

The final aspect of harnessing the wisdom of the crowd is the evolution of a method of aggregating information. User ratings and user recommendations are registered on content pages that have a natural method of weeding out undesirable and irrelevant content by ignoring them; and enhancing valuable content by re-enforcing, promoting and propagating them. Many web-sites provide such aggregation and valuation features that work wonders in naturally selecting viable, valuable content.[20]

A map portal is ideally suited to harness the collective contribution and intelligence of the crowd to build reliable, authenticated, updated and accurate conservation information. Distributed local residents situated and working in the local geography have a compulsory understanding of their geography and environment. And humans, like every life form, have an innate ability to create a mental map of their local environment and resources.[21] The conservation monitoring map portal will provide a platform to enable the contribution of information on local geographies from distributed people situated in local geographies.

Initially much of this contribution may be inaccurate. A site that does not certify quality will soon become irrelevant. Tagging and rating of information by users would provide the first level of validation and authentication of data. And with more active users, the reliability of data increases. In addition to this process of natural selection, we may need to add more levels of authentication and verification. We would build three more levels of validation. A locale based

[20] Redit is a website providing hyperlinks to other content and allowing users and individuals to rate, promote and demote hyperlinks. The site can also be customized to learn and suit individual preferences. This can apply to news sites, information sites, music sites and whatever.
http://reddit.com/
http://pandora.com/

[21] This mental map and understanding is independent of the education and technical expertise of the individual. Participatory Rural Appraisal methods developed by Robert Chambers (IDS, Sussex), and extensively used by development agencies around the world amply illustrate that fact that these maps are effective and true representations of local environments. In additional researchers, activists, environmentalists and local residents are a valuable source of for information about the environment.
http://en.wikipedia.org/wiki/Participatory_rural_appraisal

validation will look for patterns in the neighborhood to authenticate the data; an expert based validation will co-opt experts in the area or geography to authenticate and validate data; and finally, a versioning system that will automatically and continuously provide a verified and authenticated version and a 'bleeding-edge' version of unauthenticated and freshly contributed data.[22]

6. Elements of the Map Locator Platform

Map locator is a generic map based platform for managing user content in a participatory manner. Entire content and user participation is via the internet using a user friendly browser based interface.

Key drivers behind the project have been public access to rich geographical visualization and support for the participatory workflows making it easy for capturing user-generated content. Hence the use cases targeted by the platform are to allow, facilitate and encourage active participation and contribution by the users. The users also have access to the public data available at the site for their use.

First set of use cases targeted by the site are for browsers / readers. A user would browse site for the layer(s) s/he is interested in and then view those layers along with the features and related data available. The user will be able to download the data available on the selected layers for his/her use. This feature is available subject to the download permissions granted by the owner of the data.

Second set of use cases are for contributors / participators. A user would browse site for a set of layers, see existing data available and then enter any relevant data available with him / her. A user will also be able to upload relevant data available with him/ her to the portal so that it is available to the entire community of users.

[22] These versioning systems are very common in open source software development projects where large groups participate and contribute to build complex software systems. The versioning decisions are taken by a small group of leaders of the project.

With these set of use cases in mind, we have built a generic map-based portal and applied it to the biodiversity and conservation domain. We believe the portal functionality is generic and can be applied to many domains. The achievements of the first phase of portal development are the following:

Build a map-based platform that would provide rich geographical visualization over the Internet. The platform leverages the available Internet map servers like Google Earth, Yahoo maps, etc. to provide the base layer on which other custom and thematic data can be conveniently chosen and overlaid.

Build a framework for enabling participation and aggregation of information. The platform has a participatory infrastructure that allows easy aggregation of user generated content. All user generated content will be of different quality and needs to be curated and validated. We have built a framework with three roles on each layer. The layer administrator to manage and administer the layer, layer validators who can validate the data that is contributed and layer members who can contribute data to the portal.

Seeded the portal with geographical data accumulated and curated from various sources. The portal needed some basal data that will provide the background information for encouraging participation. We have curated and populated the portal with over 100 layers of various themes and spread across the Indian geography from the north-east India to the Western Ghats.

We have engaged with various organizations and people and built a broad-based consortium of partners who support the idea of the IBP. We have put in place a working group of various individuals and institutions who will actively be involved in guiding the evolution of the India Biodiversity Portal. We believe The IBP is a unique experiment in participation and participatory governance that has huge potential of bringing together various initiatives in biodiversity informatics and conservation and build a strong social network on citizens.

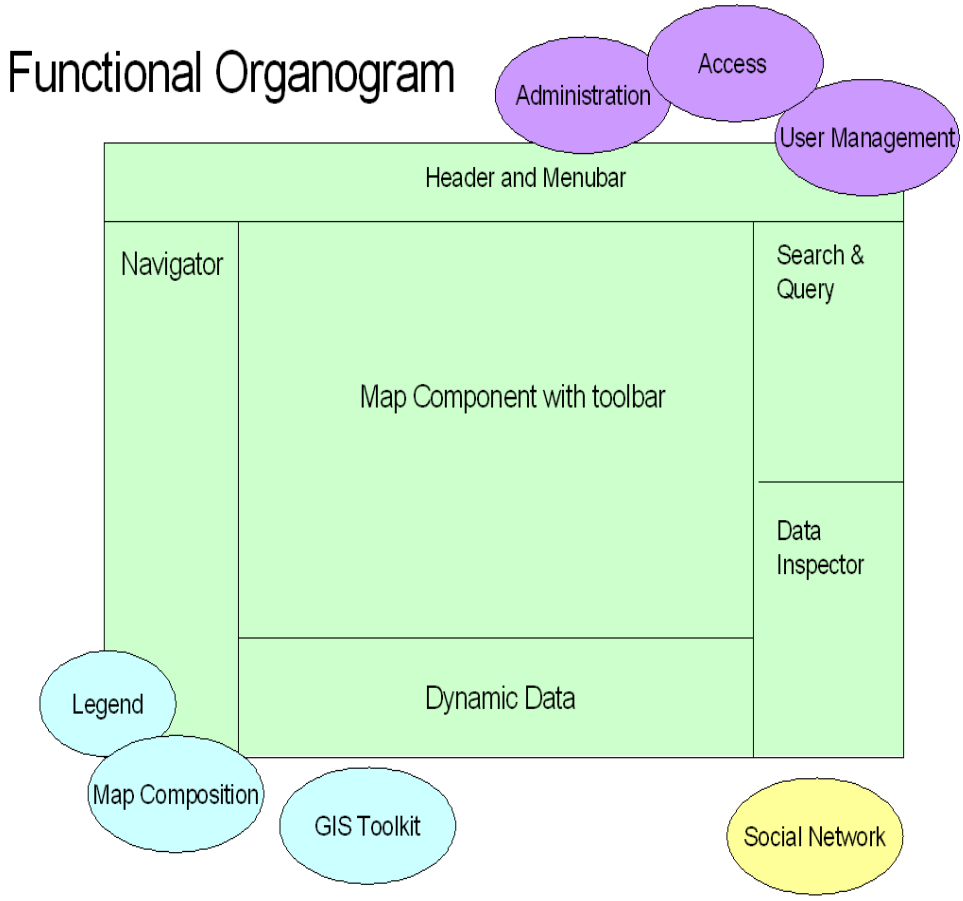

Figure 2

7. Technology and Architecture

The platform is built integrating various open source components. A range of open source components are available for the GIS domain. These are in rapid development and many sites provide a good survey and listing of various open source GIS components[23]. The major efforts are to integrated and glue various components that will provide the required functionality efficiently. The integrated product is to be made available freely to the open source to the community. The source code can be freely downloaded, modified and shared. The platform for the portal is generic and would support a variety of map-based participatory activity.

[23] http://www.osgeo.org/. This provides a good survey of open source GIS components with links to the project sites. http://opensourcegis.org/ is another site that lists various open source GIS software.

Essentially, the platform provides rich geographical visualization of layers and themes; it provides a method for users to locate an area on the map, mark it and attach multimedia annotations and comments to the location.

We will actively solicit participation in code development and would encourage actively and passively, widespread use of the platform in a variety of domains.

The map serving platform of the IBP has the following components:

- A Postgres PostGIS Database engine that stores the geographical data along with attributes[24].
- A MapServer that fetches data from the database and server polygon layers[25].
- OpenLayers javascript for fetching data from Internet map sites, our MapServer and our Postgres PostGIS database[26].
- Drupal that manages access control through defined roles, and manages all content linked to maps and features[27].

[24] http://www.postgis.org/. PostGIS is a mature open source GIS database that is provided as a blade on Postgresql (http://www.postgresql.org/) databases.
[25] http://mapserver.gis.umn.edu/. Mapserver is an active opensource map server component that is generic and generates maps that can be served for applications. It confirms to the Open GIS Standards (http://www.opengeospatial.org/standards/).
[26] http://openlayers.org/. This is a library of javascript that is widely used to render maps on the browser from various sources.
[27] http://www.drupal.org. This is a popular content management system. We have integrated this with map data and manage user-generated content in the drupal system.

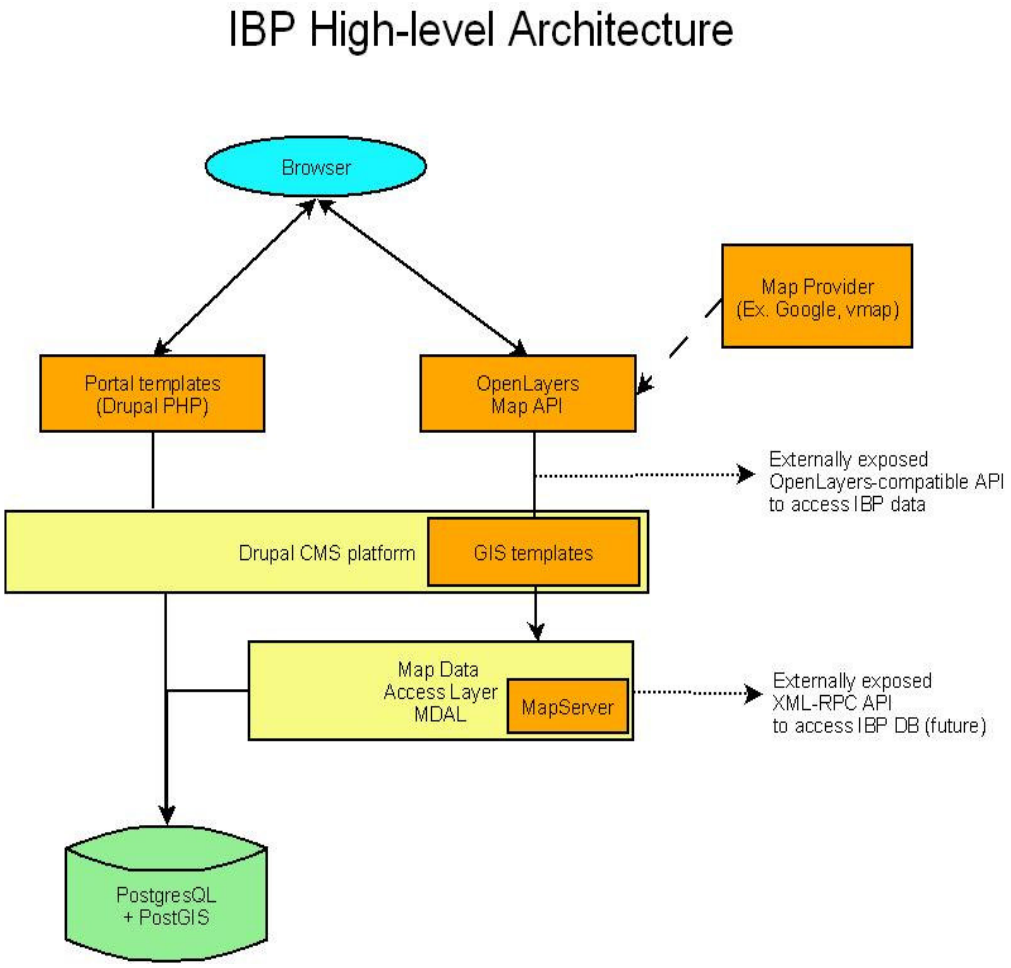

Figure 3

8. Biodiversity Informatics on the Map Locator

Biodiversity portents issues for the long-term sustenance of the human civilization on the planet. The erosion of biodiversity and the environmental changes of global warming are threatening the very basis of life on the planet. These issues are gaining international attention through various global efforts. All conservation and biodiversity information is, by definition, spatial in nature, located in a particular geography. Thus conservation information is largely driven by spatial technologies. Most conservation sites use some form of map-based web services to deploy and serve spatial data over the Internet[28, 29]. The focus of a biodiversity

[28] Many conservation sites serve map data over the Internet.
http://www.unep-wcmc.org/imaps/IMapS_help.htm
http://www.ecoinfoindia.org/
http://www.conservationmaps.org/index.jsp

informatics and conservation portal should be to provide reliable, updated and comprehensive information on biodiversity over the Internet.

- It should encourage participation and solicit data and information from users on the Internet.
- It should have strong visualization features that are intuitive and allow the non-expert user to freely interact with the data.
- It should have a robust mechanism for authenticating and validating data.
- It should have rudimentary spatial analysis capability.[30]
- It should be sustainable and adaptive to changes in technology and user needs.
- It should be open and free.[31]

9. The India Biodiversity Portal (http://www.indiabiodiversity.org)

India is home to an exceptionally high level of biodiversity, and to nearly one-fifth of the world's population. Just 17 of the world's 170-some countries contain 70 percent of its biodiversity, earning them the title "megadiverse." India is one of these megadiverse countries. Unfortunately, India also has four (of about 34) "global biodiversity hotspots" - unique, biologically rich areas which are facing severe conservation threats. The rapid rate of hotspot degradation makes it imperative that conservation science be pursued immediately and

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http://plasma.nationalgeographic.com/mapmachine/conservationmaps.html

[29] Various proprietary and open source web platforms are available for serving spatial data. Many map-based web servers use proprietary software like ESRI's Internet Map Server, MapQuest, Microsoft MapPoint, MapInfo, etc.
http://extranet.mapinfo.com/products/Overview.cfm?ProductID=1825
http://www.esri.com/software/internetmaps/index.html
http://mapserver.gis.umn.edu/

[30] There are many open source tools that facilitate modeling and analysis of spatial data. They are widely used by researchers and provide interfaces and plug-ins for interacting with spatial data. Some of the web map servers are integrated with these.
http://openmodeller.sourceforge.net/index.php
http://www.tiem.utk.edu/~sada/

[31] A good survey of open geospatial tools is provided at the following site.
http://www.oreillynet.com/pub/a/network/2005/06/10/osgeospatial.html

vigorously in these habitats, to devise effective measures which curtail the rapidly diminishing biodiversity, and to protect unique biota from the onslaught of humanity.

The value of this biodiversity is immense (including economic, social and cultural) and its potential future value is far greater. To take an example, the ecosystem services from the forested watersheds of the two great mountain chains of the world, the Himalayas and the Western Ghats, indirectly support several million people in India. The economic value of such ecosystem services is immense. The non-timber forest products alone have been estimated to be worth $200 million per annum. The existing biodiversity also has the further potential to add billions of dollars to the country's economy, in new products from its unique species, and from services such as ecotourism. Information about biodiversity combined with India's expertise in information technology and emerging strength in biotechnology has the immense potential to increase the current and future value of the country's biodiversity.

India biodiversity portal is the first application using the Map Locator framework. The platform consists of multiple functional components to achieve different functionality. Key components of the platform are listed below

9.1 Base Map for Visualization

The base map provides the background visualization for the maps. These base map images are fetched from Google maps directly by the client browser based on the view port. You can choose from Google Physical, Google Satellite, Google Hybrid, and Google Streets, from the drop-down menu. On slow networks, fetching the Google images as tiles from the client could take some time.

9.2 Map Tree Panel

The portal consists of layers or maps organized by Themes and Geography. Themes show a collection of the maps into different groups that are relevant to biodiversity and conservation.

Geography shows maps organized into an India level maps, and maps of specific locales. The layer tree on the left shows all the maps currently available on the portal.

Click on a category to expand the tree and show a list of maps available in each category. Click on the check-box next to the map to display the map. The currently displayed map will be in bold and will show the top-most active map on the portal. The title of active map will also be displayed on the map above the map navigation toolbar. Features on this map are clickable. You can display multiple maps on the base map. All maps other than the active map displayed will be faded but will be visible on the map.

Often, clicking on a map will display the map in the map frame, but the map may not be visible. This is because the map is of a small area and the map view shows a larger area and does not show at the current zoom level. If you want to see the features in this map, you have to zoom into the area of the map. You can do this by clicking on the "Zoom to Extent" icon next to the map. This will zoom into the the extent of the displayed map and show the features on the map.

Often, when you are zoomed into an area and you click on another layer, you will be shown a pop-up saying the features of the map are outside the current extent. You can choose to zoom to the extent of the currently displayed map or you can choose to maintain the same extent. If you choose to maintain the same extent, you will not be able to see the features of the newly clicked map.

At any time, you can zoom to the extent of any of the displayed maps, by clicking on the "Zoom to Extent" icon next to the map in the tree.

Clicking on the map name will pop-up the map information. This shows a summary of the extent of data attached to the map and a brief write up about the map. Details of the map information pop-up are explained in the following section.

9.3 Layer Manager

Click on the icon in the tool bar on the left panel to bring up the layer manager. The layer manger shows all the maps currently displayed. The top-most map in the layer manager is the active layer. The active layer will also be shown in bold in the tree and is displayed on the map panel, above the map navigation icons. Note that only the top-most layer is clickable. The features of the active layer are also prominently displayed on the map, while all other layers are visible, but faded from view.

The Layer Manager allows you to reorder the layers and change the active layer. To make any other map in the layer manager the active layer, click on the layer and drag it to the top of the list. Now this will be the active layer. It will be seen in bold in the layer tree, the name will be displayed on top of the map panel icons, the features in the map will be displayed brighter than the features of all other layers, and the features will be clickable.

The layer manager also has an information icon that will launch the map information pop-up. If layers are participatory, it shows a participatory icon. And you can close a layer and remove a map from the map view.

9.4 Map Information Popup

The map information pop-up can be accessed by clicking on the map name in the layer tree, by clicking on the map title on the map panel and by clicking on the information icon in the layer manager.

The map information pop-up lists all the data that is associated with the layer. It shows the attribution, the license if any, associated with the layer, the individuals who have worked on the data for the IBP.

Below the basic attribution and related data, it lists associated data with the layer. Click on the + to see the layer attributes. This panel shows the data that is associated directly with the map.

For each feature of the map, there could be additional data. For example, at a water body location there could be a list of bird sightings. These are organized as linked data to the layer. There could be one or more linked data. Click on the + to see details of linked data.

For any column in the data, there could be some general information available. For example, if there is a species associated with the data, the species could have additional taxonomic, habitat, photo essay or any other information. This data does not concern the particular location, but is like a library resource on an item in the data. These are designated as resource tables. Click on the + to see the details available on the resource associated with map.

9.5 Feature Pop-up

Click on a feature to see more details on the feature. This will bring up a pop-up attached to the feature that shows a summary of associated data with the feature. Click on the details link to see all the details associated with the feature. If there is linked data associated with the map, the linked data will be shown as a tab in the feature details pop-up. Click on the tab to see linked data.

If resource tables are associated with the data, these will be shown as links in the details table. The details table can be sorted, searched and paginated to the desired number of rows to be shown.

9.6 Legend

The legend tab is accessed by clicking on the tab in the right panel. This will bring out the legend tab. The legend is currently available only for polygon layers. The legend shows the categories and the color code for each category.

9.7 Data on Demand

Click on the Data on Demand tab at the bottom of the map screen. This will bring up a table with all the data for the features on the active map visible in the map frame. The table allows

sorting, searching, and setting pagination. The data on demand will show a maximum of 250 features in the table. If there are more than 250 features of the active map on the map frame, zoom in to see the data of a lesser number of features.

The data on demand table is linked to the map. Thus clicking on a row in the data on demand table will bring the pop-up of the feature on the map.

10. Challenges and Future Direction

The India Biodiversity Portal has been launched and is currently populated with a 100 maps covering 13 geographical areas spread all over the Indian sub-continent. There are currently 6 participatory layers on the portal. The platform is under active development. And in the nature of a web 2.0 application, we intend adhering to the philosophy of a perpetual beta. We intend putting out monthly updates of the portal with more functionality and more curated data.

The platform will be expanded and applied to other domains and other application. Over the next six months, we are working on a project funded by the Stockholm Resilience Center for serving details urban maps of 12 global cities that include Bengaluru, Cape Town, Canberra, Helsinki, Istanbul, New Delhi, New Orleans, New York City, Phoenix, Chicago, Johannesburg and Stockholm. This project focuses on a set of common research questions including questions such as: What are the effects of urban development and land use change on biodiversity and ecosystem service delivery? How are different socio economic groups affected by environmental changes in urban regions?

Our future directions will be guided by the following principles:

Governance and management

- Operate in perpetual beta with regular monthly updates
- Develop the project as an opensource project and build a community of developers
- Conduct road shows to solicit participation on the portal with biodiversity and conservation data

- Build governance structures for managing the portal

Technology

- Better user interfaces by conducting usability workshops.
- Build rich flash based visualization for better user experience
- Build modules for spatial analysis
- Provide mechanisms for spatial integration of narratives
- Build a maps composition module with the notion of layer groups
- Improved map graphics with choropleths
- Attractive theme based navigation
- Leverage the semantic web by interaction with other portals

Business

- Expand the application of the platform to other domains
- Provide services in building custom map-based applications
- Mature the platform to a product in the domain of web-mapping
- Create a brand and profile for the platform
- Provide global leadership in the area of web-mapping applications

10. Conclusions

We have been seeing rapid changes in the area of geographical visualizations and map-based applications. These have largely been driven by the easy availability of high-resolution imagery, the growth of geographical visualization, the cheap availability of mobile location-based devices. These have liberated the domain of geography and unleashed a slew of location-based applications from more efficient supply chain management to location-based buddy identification and social networking sites.

The current Map Locator application intends to ride this wave of location-based application. We have developed a robust and scalable platform that helps geographical visualization and efficiently solicit user-generated content. A structure of aggregation allows validation and

management of this user generated content. The platform is in rapid development. We have used the application for the India Biodiversity Portal (http://www.indiabiodiversity.org). We are currently building the platform to serve data from the ambitious Urban Atlas Project that will map twelve cities of the world.

We intend to actively solicit participation in code development from the open source community and strive towards using the platform and expanding to other domains where such map-based sites have huge potential. We believe we are at the tip of an exponential wave of growth in location-based applications and intend to create the wave and ride it.

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