The User-participated Geospatial Web as Open Platform[1]

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ABSTRACT

The effect of broadband penetration leads Web 2.0 as data platform of user participated contents in the world. Especially Google Maps enables for users easy to add annotations, location data via Open APIs. There are some of characteristics in recent innovation of web GIS. 1) easy way to use base maps such as satellites images, 2) mashup of social data, 3) open standards for annotations, 4) open sources for GIS softwares and 5) connection between desktop and web services. Google, Yahoo! and MapQuest have offered own web APIs for user with open standards. It evolves mapping platform as a service for user to be participated. For example, this paper shows some of mashup examples the combination of base map such as Naver and Google.

Keywords: Web Mapping APIs, Mashup, Open Source GIS

Introduction

Nowadays the Web 2.0 has been popular terms in the internet business. The new era of Web 2.0 is presented by "Web as a Platform." It often applied to a perceived ongoing transition of service as softwares. In past, web sites only offered read-type services such as books, magazines. But, new trends covers read-writable services based on user-generated contents by collaborative intelligence, tagging, blogging and etc. It covers from a collection of user's data, Ajax style web applications like Gmail, Google Maps to participations of end-users. It expects that ultimately Web 2.0 services will replace desktop computing applications for many purposes. During a couple of years, these explosive growths made the world to recognize new trends and started to impact other rest of software areas.

The geospatial Web was made slow progress until various web based map APIs were offered. Most of geospatial web vendors just continued their services as an application service provider(ASP) such as MapQuest. Vendors of traditional Geological Information Systems (GIS) such as ESRI, MapInfo were not interested in geospatial web as a service to end-users. The change came from Google Maps that offered Ajax-based mapping service that can be navigated by dragging the mouse, or using the mouse wheel to zoom in (mouse wheel up) or out (mouse wheel down) to show detailed street information. Users may enter an address, intersection or general area to quickly find it on the map. Google created the Google Maps API to facilitate developers integrating Google Maps into their web sites with their own data points.

Also there are various convergences of technology that excellent base map services (street map, satellites etc) easy to be used, mapping APIs that can be integrated with other web sites and user-participated annotations to can be determined locations (geo-code based marking), and 3-dimentional softwares that present geographical features. These are recent innovations from outer traditional GIS

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industry that anyone could not be expected. It originated by web mapping platform (read-type) and user's participation (write-type) based on these platform. This report will compare features of geospatial web in now and past and review various characteristics of user-participated geospatioal web.

New Geospatial Data Platforms

Traditional web mapping distinguished static made in raster images and dynamic web maps by servers. However, today in the light of an increased number of different web map types, this classification needs some revision. According to classifications of Web mapping in Wikipedia, there are additional possibilities regarding distributed data sources, collaborative maps and personalized maps. It means there are many methods to gather user's geodata and combine between them and geomaps.

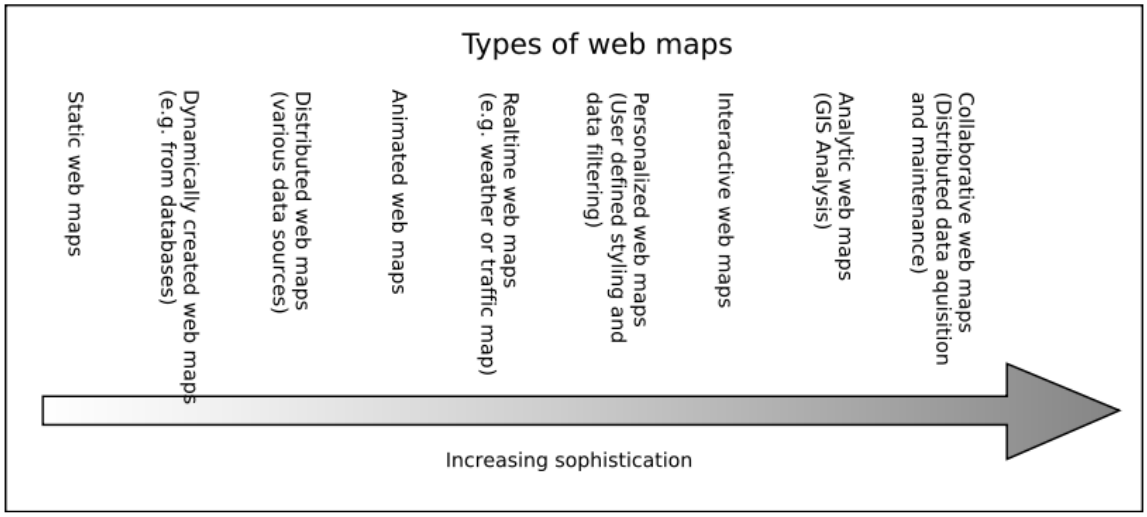


Figure.1 Type of Web Maps (http://en.wikipedia.org/wiki/Web_mapping)

Especially Web 2.0 focused on 3rd party web developers and alpha users who consume Yahoo!, Google, Amazon, eBay, Salesforce.com, and Flickr APIs and produce cool and useful web applications from them. It seems like ecosystem of software plaforms such as Microsoft's .NET framework or Sun's Java technology.

While GIS also restricted to normal programmers and users caused by expensive programs can be used by highly-trained specialists. Just MapQuest and Yahoo! Maps brought easy-to-use mapping tools to the public. Recently the release of Google Maps demonstrated to web developers and users the possibilities of navigation and opened a floodgate of interest in online mapping. Google Maps was not released with an application programming interface (API), but some of developers hacked its structure and combined their data to that.

After release of Google Maps API, the speed of its adoption shows the essential demand for location-based services that normal programmers can use although it was not easy way you incorporate it into their own applications. It means developers want to build own applications around the locations in all our data, but that their needs aren't being met by the existing geospatial offersings such as traditional GIS vendors

Nat Torkington was firstly introduced the terms of “Where 2.0” of another web as a platform based on location based services by normal users and grassroots developers with open based map providers.

Table 1. shows differences between traditional application platforms and Where 2.0 platform.

Where 1.0	Criteria	Where 2.0
USGS, Landsat	**Base Map**	Google, Yahoo!, Microsoft
ESRI, MapInfo SDK	**Softwares**	Web Maps APIs
Topography, River, Building	**Layers**	Photo, Video, Tour Spots, Blog
Oursourced digitizing vendors	**Participators**	Web users
GML, WFS, WMS	**Standards**	GeoRSS, KML
Government, local GIS vendors	**3rd Party**	Mashup developers

Table 1. Comparision Chart between Where 1.0 and 2.0

Where 2.0 consists of a set of techniques and tools that fall outside the realm of traditional GIS. Where 2.0 developers use a mapping API like Google Maps, talk about KML, GeoRSS versus GML, and gathers and show his photos to make a map of his favorite trips. And its 3rd party is normal web developers and alpha users rather than local GIS vendors.

Business model is not yet clear in Where 2.0 model. But, there are many tryout to connect location data and big search business. It's a multi-billion dollar market that overlaps with online search, local advertising and is applicable to vast range of commercial applications.

Geospatial Web APIs

Recently most of the major online service providers offers a mapping service for users and a mapping API for developers. So competition is fierce, the stakes are very high. There are over 50 APIs related to mapping and geo-location in Programmable Web(http://programmableweb.com/apis) that offers classified Web APIs. That's a lot of mapping-related APIs and constitutes about 10% of all the APIs listed at that.

Mapping API providers

Major players are Google, Yahoo!, Microsoft and AOL MapQuest. Each of these major vendors offer developers a free level of service as well as fee-based commercially licensed options. These for-fee services include Pushpin is a an enterprise-friendly licensed offering with advanced GIS features such as custom layers along with Google API compatibility.

Table 2. is an informative comparison of different mapping APIs such as Google, Yahoo, AOL MapQuest and Microsft Live. Each providers have pros and cons for different parts. When choosing a provider it is worth considering various things such as geocoding, traffic, routing and local search APIs. In its comparison, Google Maps comes out on subjective top. Though Google's was the first API people used to build mashups, the momentum could quickly decline if it became cumbersome to work on.

	Pros	Cons
Google Map	First Ajax based brilliant looking map International base map (Europe, Japan) Detail world-wide aerial photos Largest developer based APIs Lots of hacks and mash-up	Only Javascript libray
Yahoo! Map	First external geocoding capability Very flexible and open API's Rate limiting by IP instead of appID GeoRSS support Flash/Flex version available	U.S. and Canada only Flyouts not quite as spiffy as Google
AOL MapQuest	Frist routing (driving directions) capability Geocoding capability Large users and big market share	No smooth Ajax client (yet) Slow functional changes Weak documentations
Microsft Virtual Earth	Well documented and sample sites Detail Building shape and 3D view	Low Performance

Table 2. Comarision Chart of major mapping API providers

In contrast, traditional data source vendors also offered their business APIs for location-based advertising. The deCarta offers many features of interest to commercial applications like routing. GlobeExplorer offers this API with access to the world's largest database of aerial and satellite imagery. In local scale, Multimap offers european mapping APIs and in Australia and New Zealand there's the Whereis API and ZoomIn API.

In Korea, Naver has offered their own map API buying map data since 2006 whreas most of internet portals offered mapping services by application service provider (ASP) such as Congnamul and Sundo Soft. Most of ASPs in Korea changed their raster based map service to dynamic Ajax technology, but public APIs are not released yet because it may threaten their business models.

Location data providers

There have been many service providers gathering user-generated location data and mapping them in base maps. Users can simply mark favorite places and add annotation, photo and review. For "personal geography" and social community mapping there's the Platial and WayFaring API. Platial makes maps of unique places, a socially networked mapping platform which makes it easy to find, create, share, and publish maps and places.

Smilarly Plazes connects you to the people and events around you by sharing your activities. You can use it to share your current location and activities or your favorite hangouts with others or to find out what your friends are up to. Or use it to keep track of all the cool Plazes, activities and people in your life, and share your location and discover others nearby with the Plazes API.

Also GeoIQ is an open platform that allows you to create applications integrating your data and other folks' data using Google Maps and Microsoft Visual Earth APIs. This combination provides not only interesting visualizations such as heatmap, it also allows for fairly complex analysis in an easy-to-use interface. GeoIQ operates as a Web service; the API lets you configure its usage, the data sources and the level of analysis.

Open source providers

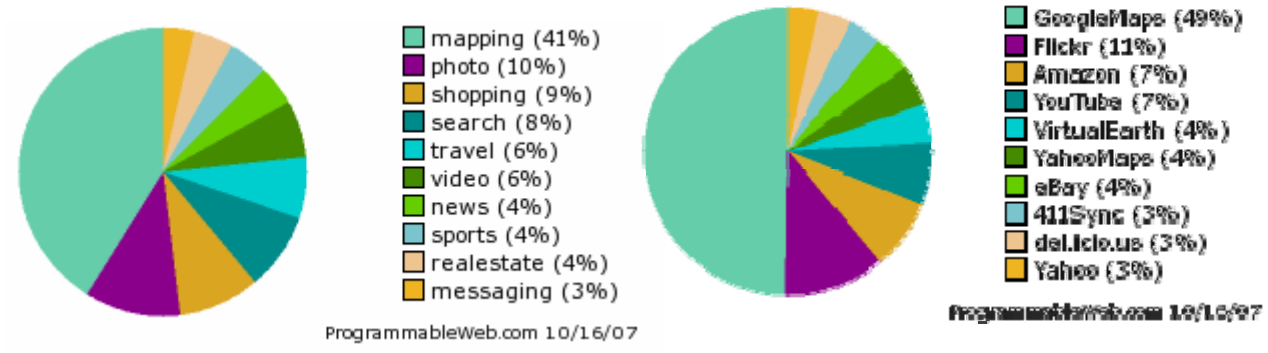
Some of providers give free code and data based on a philosophy of open source softwares. OpenLayers open source JavaScript mapping library initially developed by MetaCarta. It makes it easy to put a dynamic map in any web page and can display map tiles and markers loaded from any source. MetaCarta developed the initial version of OpenLayers and gave it to the public to further the use of geographic information of all kinds. OpenLayers is completely free released under the BSD License. Also if you want to write a single set of code that spans multiple mapping APIs you might want to try Mapstraction, a JavaScript library that provides a common API to Google, Yahoo! and others.

This includes APIs like the USGS Elevation Query Service from the Geological Survey returns the elevation in feet or meters for a specific latitude-longitude point. NASA provides mapping images via their satellite image API. If you are looking for alternate Mapping solutions you can also try Modest Maps, Mapstraction. All of the open source frameworks have their advantages and all of them support the larger mapping providers.

Mashup of Social Data

We reviewd various map API providers can be mixed each other. Mashup is web application that combines data from more than one source into a single integrated tool such as map API. There are many open APIs to treat data and make a transaction between API providers and customers via open standards such as XML and REST protocol.

Especially Map mashups are so popular and are such a quintessential use of online APIs that a lot of people incorrectly assume that all mashups use maps. The first real use of the phrase "web mashup" in this new era can be traced back to Paul Rademacher's HousingMaps.com http://www.housingmaps.com built in early 2005 shortly after the Google Maps service was released (but before Google even had an official API). Paul created a popular service that used real estate data from Craigslist and plotted property listings on Google maps to make something genuinely more useful than the sum of the parts.



(a) Top Mashup Category (Total: 2,114) (b) Top APIs List (Total: 533)

Figure 3. Popularity of Maping APIs for Mashup

Figure 3. shows how many map APIs use to make mashup services. Over 40% of mashup are mapping between social data and base map. Also Over 50% of APIs are almost mapping tools such as Google Maps(49%), VirtualEarth(4%) and Yahoo! Maps(4%).

As followings are typical sample lists of mashup between mapping APIs and other data.

Google Maps Examples

1. Chicagocrime http://www.chicagocrime.org - A freely browsable database of crimes reported in Chicago overlaid onto Google Maps APIs
2. BBC News http://www.benedictoneill.com/content/newsmap - See where the latest news is happening in the UK
3. Quebec Wines http://www.quebecwines.com/qw_quebecwineriesmap.php Show the location of the wineries in Quebec and related wine information APIs: Amazon E-commerce, Google AdSense, Google Maps, Google Search
4. World of Warcraft Map http://mapwow.com/ A World of Warcraft Map that includes Herbs, Ores and Treasures APIs

Yahoo! Maps Examples

1. Themed Maps http://justin.everett-church.com/ymaps/radarMaps.html Flash developer Justin Everett-Church used the Yahoo! Maps Flash API and some crazy Flash 8 filters to create really nice looking themed maps.
2. Flickr Maps http://www.sodascope.com/FlickrMapsExt/ For cities across the US, Michael Hoch puts Flickr photos on Yahoo! Maps using the Flex API. This application is another great example of how Yahoo! Maps APIs give you full control over the look and feel of your mapping application.
3. MashUpcoming http://www.mashupcoming.com Beau Ambur shows the power of Yahoo! Maps with Flash & Events from Upcoming.org to deliver a rich experience. Kudos to Beau for integrating smart features like Traffic and Local Search.

Microsoft Virtual Earth Examples

1. MSNBC News Map http://poly9.viavirtualearth.com/Poly9/MSNBC/ Mashup with MSNBC plots the location of news events around the world and allows searching by news department and time period.
2. Virtual India http://research.microsoft.com/virtualindia/ Virtual India is a research project by Microsoft Research India, in collaboration with the Government of India's Department of Science and Technology.
3. Geotag It http://atlas.dotnetslackers.com/Mashup.aspx This applicaition allows any location in the world to be geotagged. It also allows you to associate del.icio.us posts and Flickr photos with a location.

Open Standards for Annotations

As the number of mapping platforms increases, standards start to be more important. If data providers wants to offer access to its database for people to include in their own mashups or applications, what data format or web services API standards should they adhere to? Of course, there are also standards format to be exchanged between each GIS vendors that have each different formats.

The Open Geospatial Contotitum (OGC) has beend developed this work since 19976. It defines several web services: WFS (Web Feature Service) and WMS (Web Mapping Service) are the two big ones. WMS describes the basic map (either as tiles or as lines) and WFS describes the features on theat map. NASA Worldwind gets its imagery through WMS, and they're adding WFS support. There are hacks to get Google Earth to display WMS data, but it’s very heavy to be treated by general users and normal developers.

GeoRSS arose out of this need to share lists of points. It is an extension to the common RSS (Really Simple Syndication) used on web sites to notify readers of new articles or updates. GeoRSS adds geographic coordinates and features to RSS and Atom items. It was firstly adopted by Yahoo! Maps.

```
<entry>
<title>M 3.2, Mona Passage</title>
<link href="http://example.org/2005/09/09/atom01"/>
<id>urn:uuid:1225c695-cfb8-4ebb-aaaa-80da344efa6a</id>
<updated>2005-08-17T07:02:32Z</updated>
<summary>We just had a big one.</summary>
<georss:point>45.256 -71.92</georss:point>
</entry>
```

Whereas Google Earth had a similar need several years ago, and created KML (Keyhole Markup Language) for its particular needs. KML is like GeoRSS, but with camera angles, styles, overlays, and many other presentation features built in. GeoRSS and KML are just data interchange file formats.

Google Maps already supported both format:

1. GeoRSS (http://maps.google.com/maps?q=http://slashgeo.org/index.rss)
2. KML (http://maps.google.com/maps?q=http://kml.lover.googlepages.com/my-vacation-photos.kml)

Also OGC defines the GML format, which KML bears some resemblance to. GML is notorious for being a superset of features of the products whose companies worked together to define the format. This means that it's complex and quite scary--KML is more accessible, and GeoRSS even more so.

Microformats are used in web pages to identify common data such as people, places, or events. It adds meaning to the HTML by providing a standardized schema applied to the class and ID of HTML attributes, permitting manipulation of this information by other programs. There are currently two interesting Microformats: adr and geo. adr is the definition of an address:

```
<div class="adr">
<div class="street-address">23 Main St.</div>
<div class="extended-address">Suite 104</div>
<span class="locality">Northville</span>,
<span class="region">MI</span>
<span class="postal-code">48167</span>
<div class="country-name">U.S.A.</div>
</div>
```

geo defines a geographic coordinate in latitude and longitude:

```
<span class="geo">
<span class="latitude">42.4266</span>,
<span class="longitude">-83.4931</span>
</span>
```

If you use Firefox Operator extention to analyze Microformat, you can see directly map data from web contents.

But, because all the traditional GIS applications support WFS and WMS, as do storage systems and analysis tools. When you graduate from a hack to really building location intelligence into your application, you'll want to start using some of these sophisticated tools.

For example, you might want to start using PostGIS, the geospatial extensions to the popular PostgreSQL open source database so you can easily search by location. Or you might want to use the GRASS open source GIS for entry and analysis. Or, of course, you might buy commercial systems from ESRI, MapInfo, or others. So open standards are important because they let you move from mashups to infrastructure.

Open Source in GIS

The open source software is technically defined as software in which the source code is available for modification and redistribution by the general public. It is easy to become overly distracted by licenses and source code when evaluating open source software, or considering them as a corporate or project strategy. But, successful open source projects are not created by releasing free source code – they are created through the growth of communities of shared interest. It means open souce softwares have been based on participations and contributions of developers

The development of open source geospatial software is an exciting part of the new geospatial landscape. Open source project offerings cover the spectrum of tools: command-line data conversion, spatially aware enterprise databases, internet mapping applications, desktop Geographic Information System (GIS) applications, geoprocessing libraries, and more. Eager developers, companies and organizations are collaborating on the new generation of geospatial technologies, providing desktop and server-side applications, APIs, and development platforms that are changing the way we work and do business.

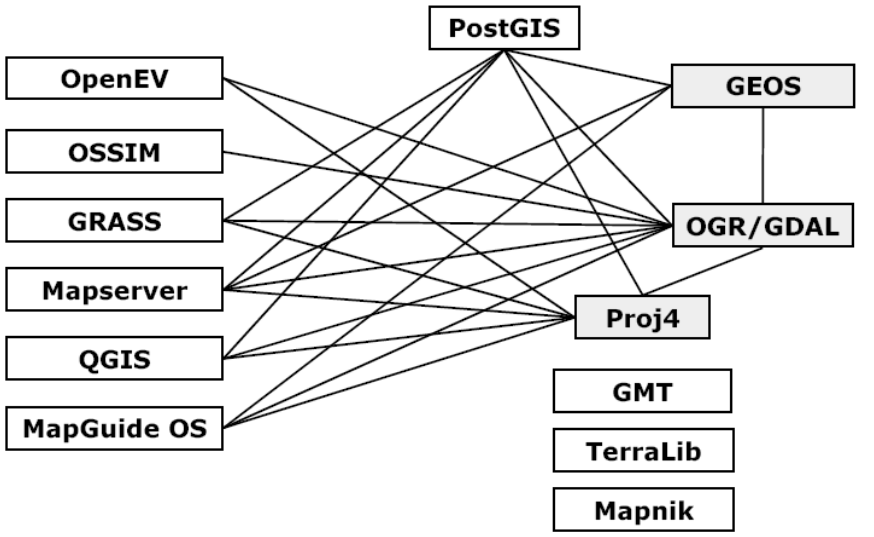


Figure 4. Open Source GIS Tools (The State of Open Source GIS, http://www.refractions.net/white_papers/oss_briefing/2006-06-OSS-Briefing.pdf)

The Open Source GIS space includes products to fill every level of the OpenGIS spatial data infrastructure stack. Existing products are now entering a phase of rapid refinement and enhancement, using the core software structures that are already in place. Open Source software can provide a feature-complete alternative to proprietary software in most system designs.

Many geospatial projects require significant amounts of data conversion. It is not uncommon to spend as much as 80 percent of your time converting data between formats and fine-tuning the way the data is organized. De facto data format standards (for example, ESRI shapefiles for vector data; GeoTIFF for raster/image data) can help you choose a format to use if you are flexible, but depending on the programs used in a project, a particular format may be required. GDAL/OGR is a translator library for raster geospatial data formats that is released under an X/MIT-style open source license.

Data often requires manipulation. There are many types of manipulation that may be needed, such as removing unwanted features, adding fields, changing attribute values, clipping features with other features, creating buffered polygons from a line, and so on. The GDAL/OGR command-line utilities are not just good for converting data, but can also manipulate raster and vector datasets. PostGIS has the ability to manipulate data as well as store it. This provides GIS-like abilities within an SQL database environment. If you are writing your own applications, particularly in C++, you can use GEOS libraries to give you spatial manipulation capabilities.

Projects that have a mapping component need some sort of visual output. The output could be a graphic file or paper printout. There are a couple of frameworks for building MapServer applications using PHP such as MapBender and Chamelon. Also MapGuide can be deployed on Linux or Windows, supports Apache and IIS web servers, and offers extensive PHP, .NET, Java, and JavaScript APIs for application development. MapGuide Open Source is licensed under the LGPL released by Autodesk.

Especially OpenStreetMap (OSM) is a collaborative project to create free editable maps. The maps are created using data from portable GPS devices and other free sources. The makers of OpenStreetMap are aiming for a wiki-like approach to map editing. Inspired by sites such as Wikipedia, the map display features a prominent 'Edit' tab, taking the user to a simple editing interface.

There are many activities in Open Source Geospatial Foundation(OSGF, http://osgeo.org) has been created to support and build the highest-quality open source geospatial software: desktop applications such as GRASS, OSSIM, Quantum GIS and gvSIG, geo spatial libraries such as FDO, GeoTools and GDAL/OGR.. Open source geospatial applications and programming environments can fill all of the standard components of a geospatial project. The geospatial landscape is becoming rich with choice.

Connection between desktop and web services

There are currently two high profile projects aiming to provide a 3D world experience: Google Earth and Microsoft Virtual Earth. The 3D objects in Google Earth are built with manual labour; Google SketchUp enables users to “build and modify 3D models quickly and easily”. Key landmarks have been prioritised and built by Google. For Virtual Earth, Microsoft have gone a step further and retained complete control over construction. Their world is built from photographs gathered by photographers, commissioned “to take millions of pictures of urban landscapes from planes, vans and motorbikes”. These photographs are then stitched together and photogrammetry algorithms used to determine the structure of the 3D world. NASA World Wind 3D visualization technology also provides for proprietary use by business and government, while both will forever benefit from evolution of the code base by Java developers everywhere.

Both of these approaches suffer from several drawbacks. First, in the Microsoft approach, one organisation is both data provider and data consumer, isolated from other data which might help them build their world. Second, the geographical coverage of the 3D elements in each application is limited. Finally, these applications have a significant installation overhead, which includes the .NET framework for Virtual Earth.

Meanwhile, web users are rapidly creating their own records of what is located where. They are doing so by geotagging their photos, blogs, and even sound recordings. With the use of a GPS device, users can specify the exact latitude and longitude which best describes their resource, and (perhaps surprisingly)

many people do. Flickr, which is currently one of the leading photo sharing and archiving websites, contains over 475,000 photos tagged with geo:lat.

Furthermore, since the launch of the Flickr Map in August 2006, users have been able to geolocate their photos without using a GPS device. At the time of writing the map contains almost 14 million geolocated photos. This ever-growing body of photographs and metadata is made available via the Flickr API. Flickr is not the sole data provider in this field. As of April 2007, ProgrammableWeb lists 17 photo-related APIs. Building a navigable 3D world from user contributed photographs is therefore an exciting possibility.

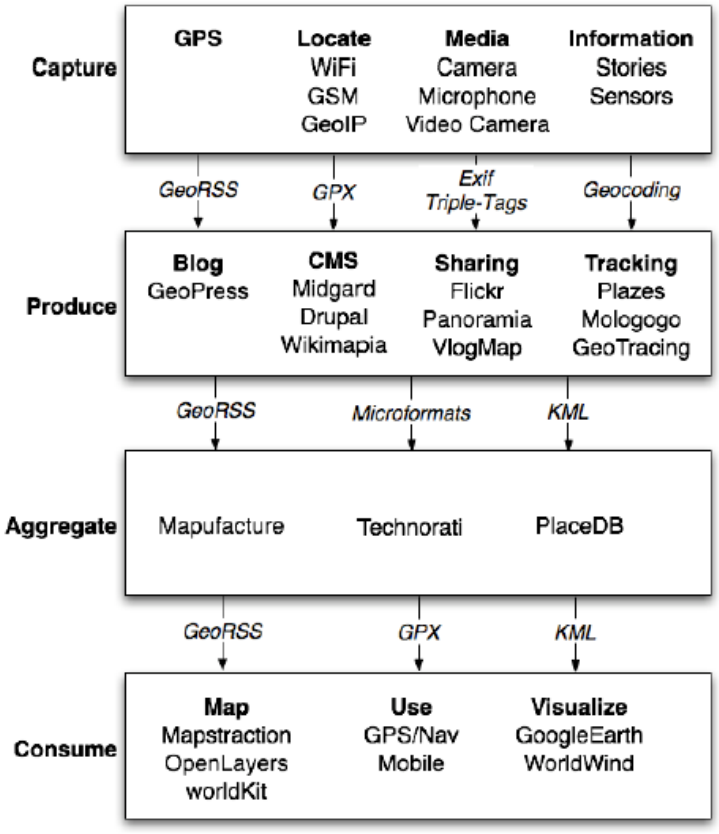


Figure 5: The GeoStack encompasses the entire life cycle of geospatial data, from capture to consume using a variety of tools, formats, and applications http://www.oreilly.com/catalog/neogeography/

The enthusiasm for photo-related mashups is second only to those based on mapping, and at the time of writing, at least 84 fall into both categories Many use the Google Maps API and Flickr API to position photo thumbnails or markers onto a map, (e.g. loc.alize.us, Zooomr) or Google Earth, (e.g. Panoramio, FlickrFly) . A recurring problem is that by presenting significantly different images side by side, the mashups lose the ability to represent what it is actually like to be at that point. Thus, thumbnails of photographs taken from the top of the Empire State Building looking down are displayed in exactly the same way as photographs taken from the bottom looking up.

So Google Earth allows to embed local images from Flickr and other sources and make another layers. Microsoft Photosynth takes a large collection of photos of a place or an object, analyzes them for

similarities, and then displays the photos in a reconstructed 3-D space, showing you how each one relates to the next. Quakr is a project to build a 3-dimensional world from user contributed photos.

Masup example of Naver and Google Maps

In Korea, there is wide broadband and mobile environment. So many unique services were developed. First, I want to introduce history of korean web based mapping services. it has been served the interactive map service such as Google Maps since 2000.

Unfortunately, it was made by ActiveX and Java applet not Ajax. In broadband and IE exclusive system, it was proper choice. It offered zoom in/out, drag-n-drop, measuring distance and squaring area, drive directions and layering bus stop and subway line etc. Last year, some of korean map services changed Ajax based and gave street photo service such as Amazon street photo service. Especially Naver released their map API to make mashup service with data from other API providers.

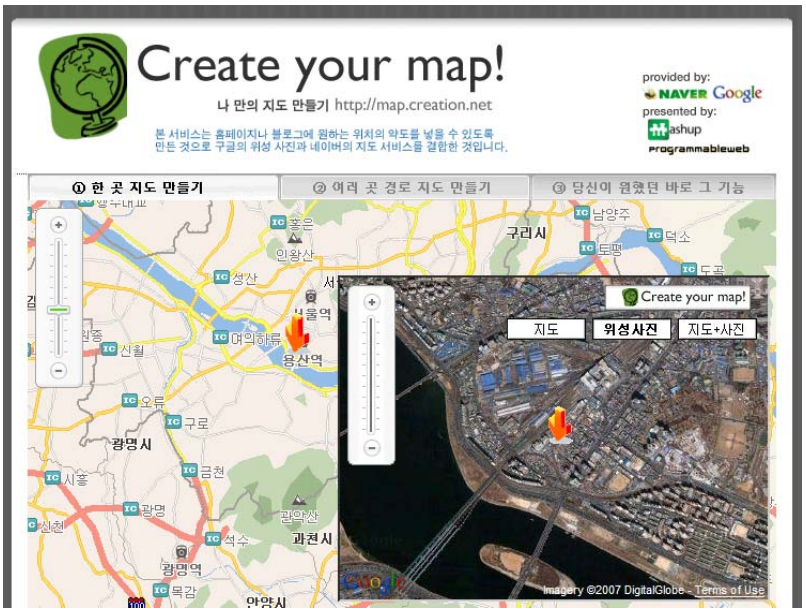


Figure 6. Screeshot of Mashup between Naver and Google Maps.

As following example(Create your map! http://map.creation.net) is to make sketch map to let people know the direction of a specific place. You can view Naver Map and Google Satallet Image together.

Conclusion

All of evidences shows that Web GIS has evolved from traditional GIS software platform to user-particiapted platform. Gathering of geo location data is very easy with digital camera and mobile GPS devices. User's annotations on the map also can be done by various mash-up services such as Platial and WayFaring. Open standards such as GeoRSS, KML and GML can be possible to share and publish them.

It can be output by Open source GIS softwares developed by voluntary developers. These new trend has changed traditional GIS software platforms to more open platform based on user's participation.

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