

Phoogle the Web – Google’s Approach of Spatial Data Visualisation

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ABSTRACT

The word „Phoogle“ is an artificial word that was created for this paper and stands for Photogrammetry and Google. In this paper it is shown how these two different things - a measurement technology and an internet search machine - are connected and how this connection will open new business models.

1. INTRODUCTION

The internet company Google has started a new service with the name “Google Maps” [1] which is a map service similar to map services like Yahoo Maps [2], MapQuest [3] or Map24 [4], but has more functionalities and offers not only maps but also satellite and high-resolution aerial images. The user interface is very easy to use and has an astonishing speed. Google Maps is at the moment still in beta phase and offers data for the US, Canada and Great Britain. Users can navigate interactively through the data, calculate travel routes or make location based searches. The search results are visualized in the maps or images and can be zoomed in and out and panned in real time. The user interface is realized in HTML, DHTML and JavaScript and does not need Java Applets or Flash elements. With that technique it is very easy for users to enrich the maps with their own data. The images come from Keyhole Inc., a start-up 3-D mapping company that Google acquired in October 2004.

Google is currently known as the most popular search machine in the internet. The main income of the company is mostly generated by advertising. With this map service technology, Google expands into the new huge market segment of local advertising. According to the Kelsey Group [5], an independent market research company, small and medium enterprises (SME) in the US spend about \$22 billion a year on local advertising. In comparison to the growth rate of overall internet advertising, the expected growth rate of local advertising is much higher. Therefore this is a very huge market where different competitors will try to become the market leader.

In this paper the main ideas of this new technology are discussed. First, a short history of the company Google is given. Then it is demonstrated, how these new services can be used and how they can be extended in order to generate impressing applications. Finally, future applications will be discussed.

2. GOOGLE

Google is a word-play of the expression “googol” that was invented by Milton Sirotta, a nephew of the mathematician Edward Kasner, to represent a number with one “1” and one hundred “0”. Google uses this expression to express the aim of the company: to organize the enormous amount of information that is available in the internet. The beginning of Google was a research project at the Stanford University that was managed by the two PhD students Larry Page and Sergey Brin, who were 24 and 23 years old. In the year 1998 they founded the company Google. Today Google has more than 3000 employees.

The Google search machine offers an user interface which is very easy to use and a comprehensive packet of search tools to access information in the internet. Meanwhile the web index contains more than 8 billion web sites. More than 200 million search requests are handled every day [6]. Currently, the main income of Google is created from selling advertising links in their search pages. The advertising links can be connected with keywords in order to aim at specific target groups. The customers are paying for every click on one of the advertising links.

Google's initial public offering took place on August 19, 2004 with an initial price of 85 dollars per share. Since that time, the success story went on. Currently (July 2005) Google has a market capitalisation of more than 80 billion dollars, which is higher than the market capitalisation of Boeing Company (54 billion) or McDonalds (35 billion). Figure 1 shows the chart of the Google share which has its value more than tripled since the initial public offering.



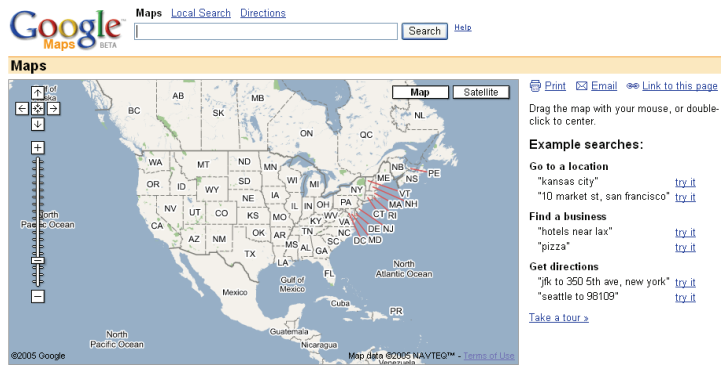
Figure 1: Price and volume chart of Google shares (July 1, 2005, © Yahoo)

3. GOOGLE MAPS

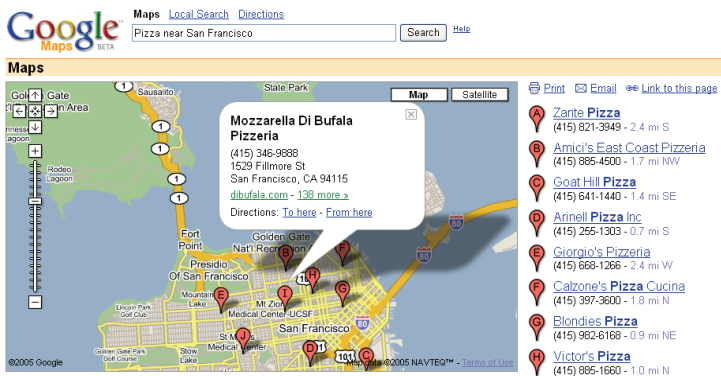
Google Maps works with Internet Explorer, Netscape and Mozilla browsers and is accessible via <http://maps.google.com>. It is realized in DHTML and needs activated Java Script. In contrast for example to Map24, which is completely realized in Java, Google Maps does not need any Java programs. Because of the Java Script realisation, Google Maps can be integrated very easily into applications of other providers (see also next section). The map is completely interactive and can be moved and zoomed either with the cursor keys or the mouse. Google Maps is connected with Google Local [7], which can handle location based searches.

The user can input queries into a search bar that is located above the map (Figure 2). After sending a request, the map moves automatically to the search area. The map can be zoomed in and out in 15 different zoom levels from global view to street level view. A very special functionality in Google Maps is the viewing of satellite and aerial images in different zoom levels. A further functionality is the possibility of formulating queries in natural language, like "Pizza in New York" or "Fuel station near Vine Street". Even though it is only a rudimentary implementation of translating natural language into a formal search language, it goes much further than existing approaches. For example Map24 allows only the search of addresses. Figure 2 shows some examples of the user interface of Google Maps.

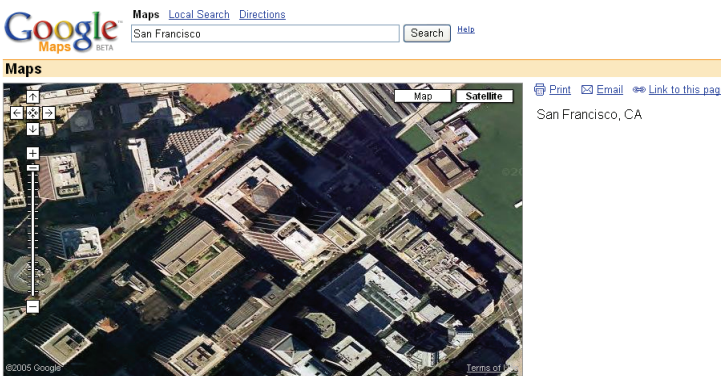
a)



b)



c)



d)

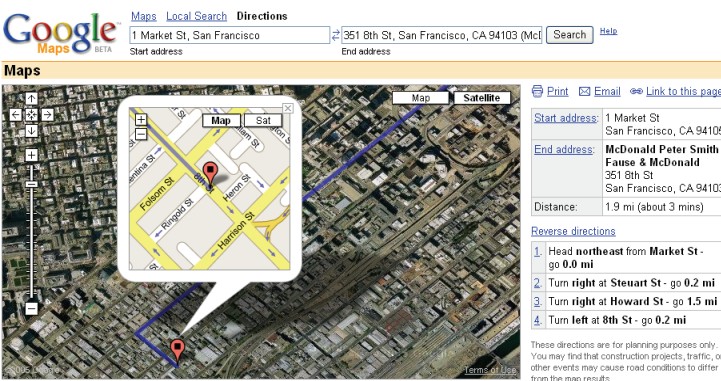


Figure 2: Examples of the user interface of Google Maps

Figure 2a shows the starting window of Google Maps that currently contains a map overview of North America. Figure 2b shows the result of the query “Pizza near San Francisco”. All pizza restaurants that were found are represented in the map with balloons and additionally in the right part of the window with their alphanumeric addresses. If the user clicks on the text link or on the balloon, further information and a link to the homepage are shown. Figure 3c shows an example of a high resolution aerial image of a part of San Francisco. High resolution images are offered at the moment only for dense populated areas. For other areas only satellite images with smaller resolution are available. Figure 2d shows the result of a route search. The route can be superimposed graphically either on the maps or on the images and is shown in text form in the right part of the window. Google Maps has the possibility to show a map and image data at the same time. If the user clicks on the start or end balloon of a route, an additional window is shown, in which the user can select between image and map view and can even change the zoom level.

4. GOOGLE MAPS APPLICATIONS

Already some weeks after the introduction of Google Maps, very interesting applications were realized that are based on the Google service. In order to embed an application, Google offers the Google Map API. Figure 3 shows an HTML code example from the Google Map API Documentation [8] in which a 300*300 map centred on Palo Alto is displayed in the browser.

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
  <head>
    <title>Google Maps JavaScript API Example - simple</title>
    <script src="http://maps.google.com/maps?file=api&v=1&key=abcdefg" type="text/javascript">
    </script>
  </head>
  <body>
    <div id="map" style="width: 300px; height: 300px"></div>
    <script type="text/javascript">
      //

      if (GBrowserIsCompatible()) {
        var map = new GMap(document.getElementById("map"));
        map.centerAndZoom(new GPoint(-122.141944, 37.441944), 4);
      }

      //]]&gt;
    &lt;/script&gt;
  &lt;/body&gt;
&lt;/html&gt;</pre>
</div>
<div data-bbox="276 694 719 711" data-label="Caption">
<p>Figure 3: HTML example for a simple Google Maps application</p>
</div>
<div data-bbox="91 731 913 783" data-label="Text">
<p>The code of this very simple example is self-explaining. The coordinates of Palo Alto are: 122.141944 W, 37.441944 N in WGS84 coordinates. In the following, some application examples are presented that are based on this technology.</p>
</div>
<div data-bbox="91 795 333 814" data-label="Section-Header">
<h5>4.1. Collaborative Mapping</h5>
</div>
<div data-bbox="91 825 915 893" data-label="Text">
<p>The expression „Collaborative Mapping“ stands for activities where users enrich maps with metadata, like images, audios, videos or even simple text. Different communities are concentrating on different contents. Some users will collect for example information about historical places, while other users will collect information about where you will find the best beer in town. This kind of</p>
</div>
```

application is also known as GeoPhotoblogging. The fusion of the user data with the maps can be done with Google API. An example for an application like this can be found in [9], in which a virtual tour of Keene enriched with images, videos and links to WWW servers is realized. The coordinates were captured with a GPS receiver.

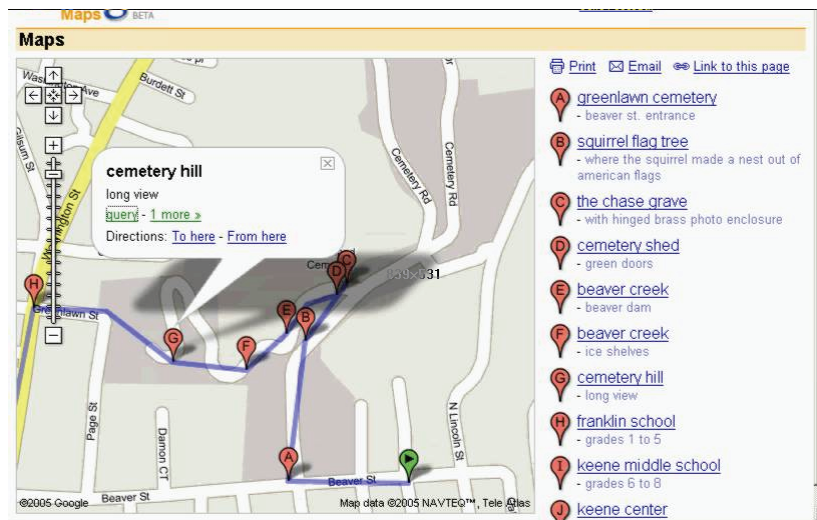


Figure 4: Example of Collaborative Mapping: virtual walking tour of Keene, NH

4.2. Ride Finder

Google Ride Finder [10] is an application that was developed by Google itself and integrates Google Maps with a real-time cab-finding service. This service uses GPS data to pinpoint the location of taxis, limos and shuttle vehicles. With Google Ride Finder it is possible to visualize cabs or shuttles that are located nearby a specific location. A click on the symbol shows the telephone number of the operating company in order to call the vehicle. At the moment, this service is only available in the cities Baltimore, Chicago, Cleveland, Dallas, Houston, Milwaukee, New York, Phoenix, San Jose, St. Louis and Washington DC. It is planned to extend this service to other cities in the near future.

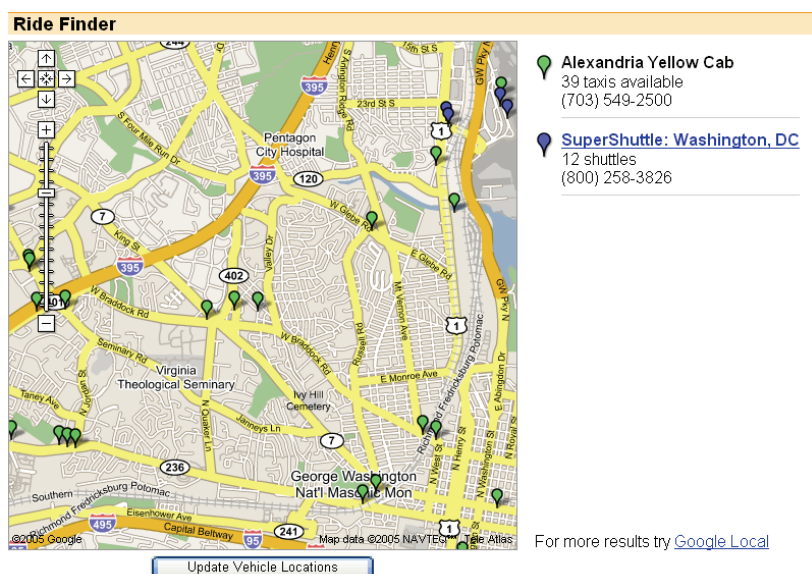


Figure 5: Google Ride Finder in Washington DC

4.3. Chicago Crime

Chicago Crime [11] is a free database of criminal activity reported in Chicago which is based on Google Maps. The site uses crime data obtained from the CPD's Citizen ICAM Web site [12], which is a publicly available database of reported crime. It is possible to browse crime by different criteria's like crime type, date, street or zip code. It is also possible to filter crimes by multiple criteria and view them on one map. If you want to rent an apartment in Chicago, this is really a valuable tool. Figure 6 shows the latest attempted armed robberies with knives or other cutting instruments.

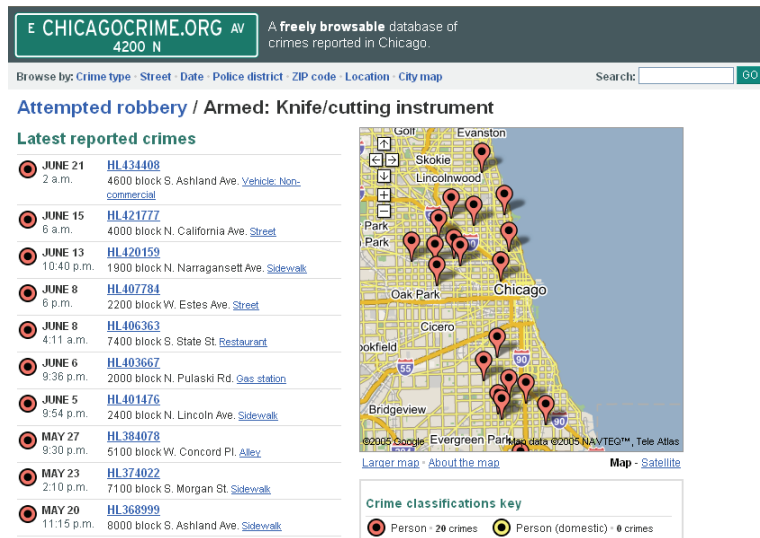


Figure 6: ChicagoCrime.org

4.4. HousingMaps

HousingMaps [13] combines craigslist real estate listings in a seamless way with Google Maps. craigslist [14] was founded in 1995 by Craig Newmark and offers (besides other information) real estate advertisements in approximately 75 cities. In HousingMaps the user can choose a city and a price range and get all places for rent in the city. If the user clicks on the bubble, details are shown (sometimes even including pictures; see Figure 7).

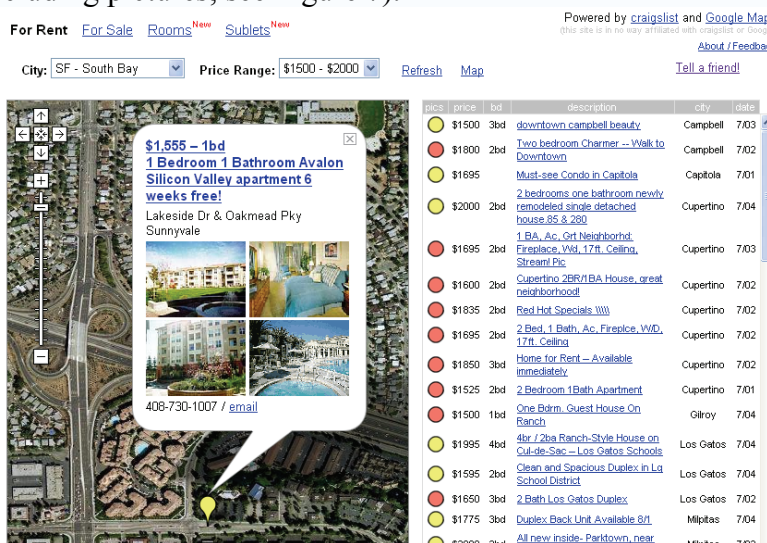


Figure 7: HousingMaps

5. GOOGLE EARTH

The free available beta version Google Earth [15] combines the functionalities of Google Maps with a 3-dimensional satellite image viewer. Google Earth is an "Application Service Provider" (ASP): providing a service for downloading satellite and aerial imagery and other geographic data. It replaces the Keyhole 2 software and is a browser independent Windows software. The database contains 12 TByte images, digital terrain models and for 39 cities 3D buildings.

When the program is started, Google Earth shows a globe which can be moved with the mouse or with the control elements in the lower part of the window. The user can zoom in and out, rotate and tilt the view. If the user inputs an address, a name or the coordinates of an object of the earth, Google Earth uses a fly-to-functionality and simulates a flight to the point and stops in a height of 1000m. There is also a local search function available which is connected with Google Local. The results of a local search are displayed in the same way with balloons as in Google Maps. Further information layer can be superimposed. For example it is possible to superimpose the street network, rivers, crime rate information or even earthquake epicentres.

With placemarks it is possible to store the position and settings of a specific view. Placemarks are like bookmarks in an internet viewer. The placemarks are stored in the folder "My Places" and can be exported with the Keyhole XML format KML. This enables the exchange of location based information through the internet. The Google Earth community offers already extensive placemarks collections.

The basic version of Google Earth is available for free. The version Google Earth Plus costs \$20 per year and provides an additional GPS interface. GPS data can be viewed, either directly input from Garmin/Magellan devices or by using .gpx or .loc file loading. Google Earth Pro is a version for business applications and costs \$400 per year or more - depending on the functionality (for example functions for spatial data acquisition). According to statements of Google Earth, the database is continuously updated with the average age of imagery ranging from 18 to 24 months. Imagery can vary in age from as new as 2-3 months to as old as 2-3 years.

Figure 8 shows some example of the Google Earth user interface. Figure 8a shows the starting window, Figure 8b a view of the Hoover Dam and Figure 8c the 3D building front of San Francisco.

6. CRITICAL QUESTIONS

Google Maps and Google Earth enable the user to do things that were impossible in the past. Some consumer protectors are pointing out that the data can also be used to violate the private sphere. This is more hypothetical, because the average age of the image data is between 18 and 24 month and the resolution is not high enough to identify people or cars for example. Another more real danger is that terrorists can use the data to spy out potential terror aims. There are already some areas which were cutted out (for example the White House) or where the image quality is reduced (for example military constructions) but it will never be possible to do this on all potential terror aims. Another problem is that collaborative mapping techniques enable the user to create questionable applications. For example in [16] an interactive map can be found that shows sexual offenders, which were released from prison. For each person the address and an image are available.

a)



b)



c)

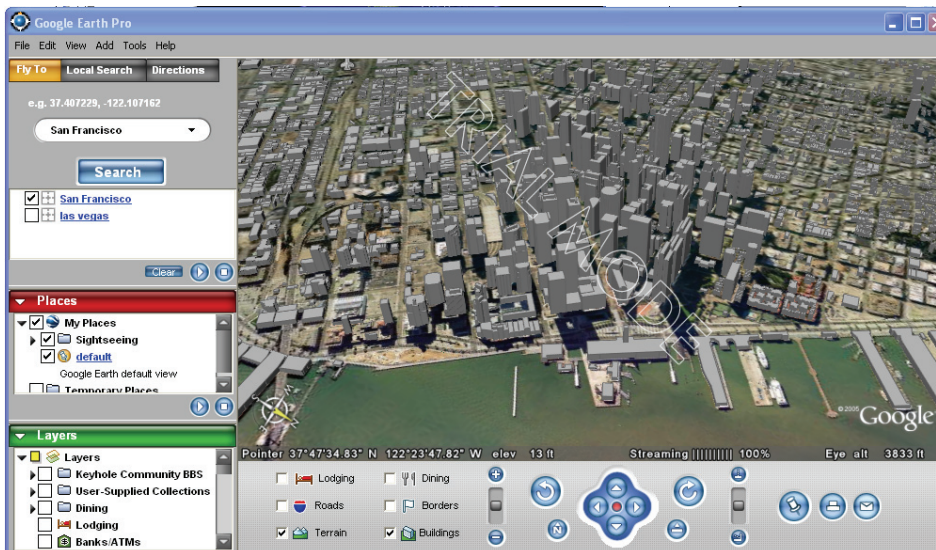


Figure 8: Examples of the user interface of Google Earth

7. THE FUTURE

Google Maps and Google Earth are currently available only as beta versions and at the moment Google earns no money with these programs. The future business model will be earning money from local advertisements. If someone wants to sell something only in a local restricted area, it is not interesting for him to place advertisements in the normal Google search pages, because the majority of the users which see that advertisement will not come from this restricted area. But the situation changes if only those users will see that advertisement, that are viewing a map or images from this area, because there is high chance that they are living in this area or they will visit this area in the near future. In that case it makes sense for small companies to place advertisements at Google.

The market of local advertisements is a huge market and also other software companies are trying to participate in this market. In May this year, Microsoft announced a MSN Virtual Earth service [17]. The functionality of MSN Virtual Earth will be very similar to the functionality of Google Earth. An interesting new data source will be 45degree-angle images of buildings. Yahoo announced in June this year the release of Yahoo Maps Api [18] that gives developers free public access to Yahoo's SmartView Technology enabling them to see their own geographical data on Yahoo Maps. Developers can now create customized maps by overlaying a variety of content onto an existing Yahoo Map.

It is very likely that Microsoft and Yahoo will get strong competitors. This will lead to a strong competition from which the users will profit. Future innovations will be necessary to become the market leader. Location based services combined with internet and mobile devices are very important in this context. The new wireless communication technology WiMAX [19], which is at the moment in the status of final standardisation, will be one of the driving motors. WiMAX will enable wireless connections with a distance up to 50 kilometres and a data transfer rate up to 70 Mbit/s in contrast to existing WLAN solutions, where the maximum distance is normally not higher than 100m.

Furthermore, the quality and up-to-dateness of the data will play a very important role. Microsoft and ORBIMAGE announced plans to deliver expanded international satellite coverage for MSN Virtual Earth [20]. Under the terms of a 5-year agreement, ORBIMAGE will allow Microsoft to incorporate ORBIMAGE's global library of satellite images into MSN Virtual Earth. Microsoft will also have an exclusive source of updated imagery that ORBIMAGE will continue to produce with its OrbView-2 and OrbView-3 satellites as well as new satellites it plans to place into service in the next 18-24 months.

In the future, also new data sources will be available. For example Google plans to use trucks equipped with lasers and digital photographic equipment to create a realistic 3D online version of San Francisco, and eventually other major US cities [21]. The trucks would drive along every San Francisco street using the lasers to measure the dimensions of buildings, to create a 3D framework onto which digital photos can be mapped. At the moment this data acquisition technique is still a research topic and it will take some more time to bring it into practise, but it shows how realistic the data in future versions of Google Maps will look like.

8. SUMMARY

Google Maps and Google Earth are one of numerous activities of Google. They are targeting the market of local advertisement which is a billion dollar market. With Google Maps and Google Earth also for non-specialists it is possible to browse terabytes of data and to use simple GIS operations. The whole geo-community, from camera producers to software developers and data providers, will profit from such applications, because the acquisition and processing of spatial data is the prerequisite for the success of such applications. Even though Google Maps and Google Earth are still beta versions, they show already impressive results. And this is only the beginning.

9. REFERENCES

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