G310

Socialization and Visualization of City Transport Using Google Maps API

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Abstract – Traffic jam is a classic problem that has always faced by big cities. One source of traffic jam is the number of private vehicles used by people in everyday mobility. Therefore, some of the city government initiated the program to encourage people to use public transport, such as in Jakarta and Bandung.

The evidence suggests there are still many people, especially certain circles or urban migrants, who are reluctant to use public transportation services because they do not know the complete information of public transportation such as the route and tariff. On the basis of the problems we are trying to build an application to introduce public transportation service and pricing estimates.

This web -based GIS application built using the Google Maps API technology that can display interactive maps and easy to use. This application is equipped with various facilities such as public transportation data entry, visualization routes, calculates distance, public places are impassable, route planning and calculation of the total tariff for two particular points on the map. The application contains information about 39 tracks and 78 routes. The application is expected used by local government to socialize the public transportation, especially city transport.

Keywords: traffic jam, GIS, Google Maps, route, visualization

I. INTRODUCTION

Traffic jam and unmanaged public transportation is a common problem in big cities. Some solution has been introduced to serve citizen better, such as building better transportation system, provide more roads and many more. But, there also some constraint in implementing the solution such as limited budget, limited spaces, priority conflict and so on.

The idea of public mass transportation has considered as a suitable solution. But it needs time, space and money to be realized. For some cities in Indonesia, build infrastructure to support public mass transportation is not easy. For example, building a new train route, provide new road, or build new transportation system such as TransJakarta. The constraint varies from budget, space, local culture and local system that tend to resist new system.

Bandung, famous as Paris van Java, is facing the same problem. Data from the Local Government stated Bandung has a population of 2.4 million. The level of vehicle ownership is high at 146.73 Bandung / 1000. The average vehicle ownership is 101.29 / 1,000 people. 0.8 Mobility vehicles in Bandung trip. While public transport in Bandung there are trains and buses. The use of trains is high at 3 million. For bus itself there are 3 kinds of Small Bus (sort of public transportation), Medium Bus and Large Bus [7].

Bandung has 36 route of small bus to serve the mobility of citizen. The local government has a program to empower and utilize the public transportation by improving the quality of public transportation services and promote them among the resident. The problem is how to promote it better, especially for urban migrant, since they do not familiar with local condition. To resolve this problem, we proposed a system to support people finding information about public transportation in Bandung, using web based application that can present spatial information. The system is expected give the user better information about route, distance and tariff for public transportation so it can help the citizen more familiar with the public transportation.

II. MAPPING USING GOOGLE MAPS API

A. Spatial and Non Spatial Data

Spatial data is geographic data related to the actual appearance of objects on the surface of the earth, such as administrative boundaries, hydrologic boundaries, land use, potential and soil characteristics, and hydrological and building irrigation networks[9]. Spatial data obtained from

maps, aerial photographs, satellite imagery, statistical data and other.

Non-spatial data is the data in the form of text or numbers (commonly called attributes), tabular form of the data that is linked to spatial data. This relationship allows the user to understand the meaning of the spatial object. Information about the attributes of a spatial object is shown as a row of data records in the attribute table. Explain the non-spatial data or spatial data as a basis to describe the spatial data.

B. Google Maps

Google Maps is a web mapping service application and technology provided by Google, powering many map-based services, including the Google Maps website, Google Ride Finder, Google Transit,[12] and maps embedded on third-party websites via the Google Maps API.[12] It offers street maps and a route planner for traveling by foot, car, bike (beta), or with public transportation. It also includes a locator for urban businesses in numerous countries around the world. Google Maps satellite images are not updated in real time, however, Google adds data to their Primary Database on a regular basis, most of the images are no more than 3 years old.

Like many other Google web applications, Google Maps uses JavaScript extensively.[13] As the user drags the map, the grid squares are downloaded from the server and inserted into the page. When a user searches for a business, the results are downloaded in the background for insertion into the side panel and map; the page is not reloaded. Locations are drawn dynamically by positioning a red pin (composed of several partially transparent PNGs) on top of the map images. A hidden *iFrame* with form submission is used because it preserves browser history. The site also uses JSON for data transfer rather than XML, for performance reasons. These techniques both fall under the broad Ajax umbrella. The result is termed a slippy map[13] and is implemented elsewhere in projects like OpenLayers.

C. Google Maps API

After the success of reverse-engineered mashups such as chicagocrime.org and housingmaps.com, Google launched the Google Maps API in June 2005[12] to allow developers to integrate Google Maps into their websites. It is a free service, and currently does not contain ads, but Google states in their terms of use that they reserve the right to display ads in the future.

By using the Google Maps API, it is possible to embed Google Maps site into an external website, on to which site specific data can be overlaid. Although initially only a JavaScript API, the Maps API was expanded to include an API for Adobe Flash applications (but this has been deprecated), a service for retrieving static map images, and web services for performing geocoding, generating driving directions, and obtaining elevation profiles. Over 1,000,000[12] web sites use the Google Maps API, making it the most heavily used web application development API.

There are four types of maps available within the Google Maps API. In addition to the familiar "painted" road map tiles, the Google Maps API also supports other maps types. The following map types are available in the Google Maps API:

- ROADMAP displays the default road map view. This is the default map type.
- SATELLITE displays Google Earth satellite images
- HYBRID displays a mixture of normal and satellite views
- TERRAIN displays a physical map based on terrain information.

The main requirement to be able to use the Google Maps API is to get the API Key. API key is a code which is the interface between the web applications that we created with the function performed. The steps to get the API Key is as follows:

1. Having a Google account.
2. Log in to the Google APIs Console page: https://code.google.com/apis/console.
3. Start a new project by selecting the Create Project menu.
4. Selecting the menu "Services", select one of the services that will be used, such as "Google Maps API v3" and change the status to "On"
5. Select the "API Access", Google will include the API key is ready for use, for example:
   ```
   ABQIAAAA8tt4eKTuBZMVnLJfP2BZrBT2yXp_ZAY8_ufC
   3CFXhHIE1NvwkxS4Rz1LFzG0odNPtk8VLkdrQF5grA
   ```
6. API key is then inserted at the script file that will access the web page functions available on google maps service is maps.google.com, as the following example:
   ```
   <script type="text/javascript"
   src="http://maps.google.com/maps/api/js?sens
   or=true&amp;key=ABQIAAAA8tt4eKTuBZMVnLJfP2BZ
   rBT2yXp_ZAY8_ufC3CFXhHIE1NvwkxS4Rz1LFzG0odNP
   tk8VLkdrQF5grA"></script>
   ```

Furthermore, earlier key can be used to insert a map from Google Maps on the web application as follows:

1. Incorporating Maps API Javascript into our HTML (Javascript snippet like the above example).
2. Creating a div element with the name map_canvas to display the map, example:
   ```
   <div id="map_canvas" style="width:600px;
   height:600px"></div>
   ```
3. Create some literal objects to save the properties on the map, example:
   ```
   var map = new
   google.maps.Map(document.getElementById("map
   _canvas"), myOptions);
   ```
4. Write a Javascript function to create map object, such as:
   ```
   function initialize() {
   ```

```
var latlng = new google.maps.LatLng(-6.4,
106.8186111);
var myOptions = {
zoom: 13,
center: latlng,
mapTypeId: google.maps.MapTypeId.ROADMAP
};
```

Setting the map is determined by the position you want to appear as in step 4 above, namely by entering longitude and latitude (map coordinates).

Parameter determines the zoom level you want. The smaller the value, the farther you are from the ground. A value of 0 will show a map of the whole world. The maximum value is 19.

MapTypeId parameter determines the type of map to be displayed, and there are four options, such as ROADMAP, SATELLITE, TERRAIN, and HYBRID.

5. Initiate map in on-load event at body tag of HTML, example:
```
<body onload="initialize()">
```

III. VISUALIZATION OF CITY TRANSPORT

A. The Problem in Public Transportation

Transportation system is a conjunction of some components or related object to move people or goods using vehicle accordance with the advancement of technology[5]. The system consists of the transports and the management that manage the transports.

Mode of transport (or means of transport or transport mode or transport modality or form of transport) is a term used to distinguish substantially different ways to perform transport. The most dominant modes of transport are aviation, land transport, which includes rail, road and off-road transport, and ship transport. Each mode has its own infrastructure, vehicles, and operations, and often has unique regulations. Each mode also has separate subsystems. On this paper we only discuss about road transportation.

The management of transportation falls into two categories which are marketing management and selling of transportation services, and management of traffic.

Public transportation, in this paper, limited to road transportation, is a transportation system using in the city, or a regency using automobile or bus that has fixed and specific route and destination, both scheduled or unscheduled.

Each destination is distinguished by color or number. The tariff usually is defined by local government, but short-distance passenger or students usually pay in lower tariff. The route or trajectory for public transportation is set by local government.

Formally, the public transportation can stop only in specific point such as a bus stop, but actually, especially in Bandung, the drivers will stopped their vehicle anywhere to pick or drop the passenger. The violation of rules is common happen such as pick the passenger or good over capacity, the door is not closed properly and many more. The violations are ignored by the officer because of weakness in applicable laws.

The problems in public transportation have strong related with the people and rules. Some of problem such as: the inconvenience environment in the vehicle, undisciplined drivers and passenger, and criminality problem[11].

Bandung, the capital of West Java, is facing the problems of public transport as well as other cities in Indonesia. The existence of public transportation is not properly empowered and some problem arise such as undisciplined driver and passenger, unbalanced distribution on public transportation to serve certain area and others, are often blamed to be the cause of traffic jam problem. The other problem of traffic jam also caused by unbalanced of amount of road users compare to roads space. It leads to an initiative to empower the public transportation to reduce the amount of vehicles in the road, especially in peak time. The initiatives include improvement of transportation system, make public transportation more comfortable and socialize the system to the citizen. It involved some stakeholders such as Transportation authority department, local government, transportation management, and the citizen.

Mosca and Zito has built the application for mapping public transport in Adelaide [10] using ArcGIS. The system can display the bus route and coordinate of bus position. But in Indonesia, recently we did not find the GIS-based system which can display the route of public transportation in the city.

B. Socialization and Visualization Transportation System

Based on problem according to public transportation as described previous, we try to provide a system to support the promotion program of using public transportation among the citizen. The system will provide visualization of public transportation route and give some information such as the tariff, public place on the route and total cost for certain route. The system should provide some functional requirement such as:

1. The system can display information about the route, tariff and distance for each route.
2. User can use the system to make a travel plan, by simulate some alternative route and calculate the distance and tariff for each alternative. It can be done interactively.
3. The system can display public place which are famous or relative important for the citizen such as mall, government office, hospital, and so on.
4. Administrator system can manage the master data such as route, tariff, road name, category, and public place.

The reference data using in this system is based on Bandung Government Decree according to public transportation, route and tariff, which consist of 36 routes. The public places describe in this application are classified into some categories such as: restaurant or café, entertainment, education, tourism,

health services, government office, transportation, and public services.

The system functionality can describe as Figure 1 below. The system will manage by an administrator who will maintain the data and tagging the map. User, anybody who can access the web, can view the map that will display the route and public places. User also can search certain route and make a travel plan. The system will display the route, distance and total tariff that is accumulated from transportation passes the route.

The identified data modeled by conceptual data model as displayed in Figure 2. The main entities are trayek, route, public place, street, and tariff. Each trayek has a route, which can differ from incoming and outgoing route. Each trayek has a tariff which is defined by government rules. Each route will consists some streets and based on the street route we can calculate the distance.

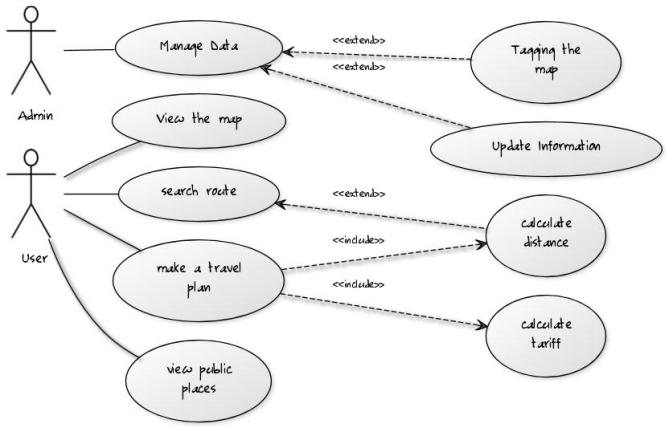

Figure 1. Use Case Diagram

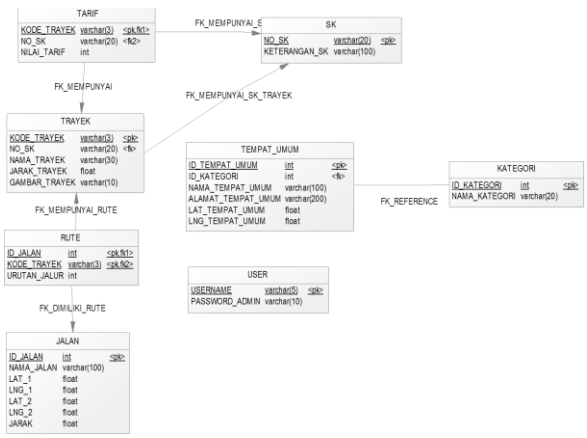

Figure 2. Conceptual Data Model

User can access the application through main panel which consist 2 options. User can choose between display the route or display the public places.

The main panel displays the map and user can choose the available trayek in dropdown text.

Figure 3. Main Panel for User

After user chosen a specific trayek, application will display the route of chosen trayek with different color between incoming and outgoing route (Figure 4), because some of them have different route. It can helps the user to decide the right trayek if they want to visit certain places. The system also display a photo and information about the trayek, and tariff in flat condition (not depends on distance).

Figure 4. Panel for display the route

Figure 5 display the panel for all public places. User can chose to display specific categories such as education, health services, or government office by clicking the menu above. The map also combined with trayek and route so the user can choose the right trayek to reach their destination places. Map also show different icon for different category of public places.

Figure 5. Public Places

The system is not implemented yet and also need some improvement such as integrated with other transportation mode (train or busses). The difficulties on this system is for administration when entering the street path data, because they have to divide the street path into some section and input each section to present the complete route. But, since it need to be done only once, the administrator can do it step by step until we can present the data completely. Another constraint of this system is the system will works well if there is internet connection available, in other words, the performance of this system depends on quality of internet connection.

The system was built without intelligent features such as shortest path and intelligent search because of lack of data on city traffic jam and other statistic data according to city transport problem.

CONCLUSION

Based on analysis and development of system which can display the map of city transport above we can conclude some point as bellow:

1. Google Maps can help us to present spatial information easily and it give us lots of opportunity to build some system and present the information spatially so it more informative than before.
2. The feature of Google Maps, through API facility, has implemented as a tools to build the system which can display the route of public transportation in Bandung. This system is expected to help the government promote the public transportation uses between the resident as a solution in reducing traffic jam and transportation problems.
3. The system is developed to display public transportation which has some features such as display the route, calculate the tariff and distance between two places, display public places and help user to make a simple travel plan.
4. The system was designed to display only small bus type of public transportation since it is a main transportation mode in Bandung.
5. The system need internet connection to operate well so the system performance is also depends on the quality of internet connection.

In the future, we expect can improve the system by adding some extended feature such as improving the search alternative so user can using vary search option, integrated the system into public transportation mode such as big Bus or train mode.

REFERENCES

[1] Asep Iskandar P. Pengenalan MapInfo. http://student.eepis-its.edu/~raisputra/GIS/ Map%20Info/pengenalan%20 mapinfo .pdf

[2] Bappenas, Modul Arc GIS Dasar. http://p3b.bappenas.go.id/handbook/docs/15.%20%20Modul_ ArcGIS/Modul_ArcGIS_Dasar.pdf

[3] Dinas Perhubungan Kota Bandung, "Surat Keputusan Walikota Bandung Nomor: 551.2/KEP.400-Bag.Hukham/2008. Daftar tarif angkutan penumpang umum di Kota Bandung." Mei-2008.

[4] Hidayat, Rahmat.2005. Jenis-jenis Peta dan Fungsi. Bandung:Garis Pergerakan.

[5] Hubdat. Direktorat Jendral Perhubungan Darat. http://www.hubdat.web.id

[6] Iskandar, Abubakar.1998. Sistem Transportasi Kota. Jakarta: Direktorat Bina Sistem Lalu Lintas dan Angkutan Kota.

[7] Jurnal Kajian HMS 2 – Transportasi Kota Bandung & Angkot Day, Kominfo, Dec 11, 2013, accessed from : http://ima-g.ar.itb.ac.id/ima-g/?p=656

[8] Google. Documentation Google Maps Javascript API Versi 3. http://code.google.com/apis/maps/documentation/javascript/m aptypes [23 Juni 2011].

[9] Pharasta, Eddy.2002. Konsep-konsep Dasar Sistem Informasi Geografis . Bandung: Informatika.

[10] Mosca, Nicola, and Zito, Rocco, "Positioning needs for public transport", Proceedings of Australasian Transport Research Forum 2011. 28-30 September 2011

[11] Virtuemagz .Quantum GIS. http://virtuemagz.com/quantum-gis.html.

[12] Zhang, Jingyuan and Shi, Hao, "Geospatial Visualization using Google Maps : A Case Study on Conference Presenters", Proceeding of the Second International Multi-Symposiums on Computer and Computational Sciences,(IMSCC '07), p:472-476, 2007.

[13] http://www.bimbingan.org/masalah-angkutan-umum.htm

[14] https://developers.google.com/maps/documentation/javascript/ maptypes

[15] http://www.w3schools.com/googleapi/google_maps_types.asp

[16] http://en.wikipedia.org/wiki/Google_Maps

G311
SIG-based Earthquake Information System

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Abstract— Indonesia has been known as an area prone to earthquakes, volcanic or tectonic earthquakes either. Therefore, it is essential to disseminate information to the public about the earthquake to raise awareness of the dangers of earthquakes as early as possible.

The GIS-based earthquake information system has available but the content has not been able to accommodate all the available information because there are many tools which are not available .The system is not equipped with several important features such as geospatial data are not managed properly so that the news delivered incomplete and has not been linked to the news location. Map shown is also not equipped with the grouping by district or tagging earthquake prone areas.

Based on these issues, we develop a geographic information system mapping earthquake which consist of important information such as data summary earthquake in Indonesia (1629-2013), the latest earthquake news, earthquake-prone maps, epicenter of the earthquake, and seismic data search by province, years, and the desired magnitude. The system is built utilizing the Google Maps API and Quantum GIS to create maps prone to earthquakes and management of spatial data.

Keywords:earthquake, map, GIS, Google Maps, Quantum GIS

I. INTRODUCTION

Indonesia is a country that has high risk in earthquake. It caused by its tectonic position which is among Asia and Australia plate, and also by the “ring of fire” or the area where a large number of earthquakes and volcanic eruptions occur in the basin of the Pacific Ocean. The line passes Indonesia from the North Maluku to West Java. It puts Indonesia into most dangerous location for earthquakes.

In the other side, the awareness of disaster caused by earthquake in Indonesia is not familiar among the citizen, because the earthquake with serious damage is rarely happens. But, recently, this country is woken by some earthquake events that caused serious damaged for example big tsunami in Aceh, earthquake in Yogyakarta, tsunami in Pangandaran, and many more.

The awareness of earthquake hazard arises among people in Indonesia and they start to learn about earthquake more intensive than before. The presence of internet technology and ease of access of information make the earthquake information distributed easier than before.

It leads the government to provide suitable information about earthquake, so the people can find information about earthquake easily.

Directorate of Volcanology and Geological Hazard Mitigation (PVMBG) has provided a website that contains information about earthquake. The website was developed with some information and also be equipped with the map so it can display the information spatially. The website also implemented the GIS technology, but the information provided is not complete and there are many tools which are not accessible by the user. This condition leads us to build a website which implement GIS technology to display information about earthquake more complete than the ones has provided by PVMBG. The aim of this system is to facilitate the public to find out information about earthquake in detail manner such as location of frequent earthquake, environmental damage caused by the earthquake, as well as areas that are prone to earthquakes. The system has earthquake data in Indonesia from 1629 -present. These data were obtained from a catalogue of destructive earthquake in Indonesia from the Center for Volcanology and Geological Hazard Mitigation (PVMBG) Bandung and BMKG website Meteorology, Climatology and Geophysics (BMKG). Mapping using Google Maps API

II. LITERATURE REVIEW

A. Geographic Information Systems

Geographic Information Systems (GIS) is a computer-based system (CBIS) is used to store and manipulate geographic information. GIS is designed to collect, store, and analyze objects and phenomena where geographic location is an important characteristic or critical to be analyzed. Thus GIS is a computer system which has the following four capabilities

in handling geographically referenced data: (a) input, (b) data management (storage and retrieval), (c) the analysis and manipulation of data, and (d) output [3].

A GIS can be thought of as a system that provides spatial data entry, management, retrieve, analysis, and visualization functions. The implementation of a GIS is often driven by jurisdictional (such as a city), purpose, or application requirements. Generally, a GIS implementation may be custom-designed for an organization. Hence, a GIS deployment developed for an application, jurisdiction, enterprise, or purpose may not be necessarily interoperable or compatible with a GIS that has been developed for some other application, jurisdiction, enterprise, or purpose. What goes beyond a GIS is a spatial data infrastructure, a concept that has no such restrictive boundaries.

Geographic data in question here is a spatial data characteristics are:

1. Has geometric properties such as coordinates and location.
2. Related to aspects such as space parcels, city, area development.
3. Dealing with all the phenomena that are in the earth, for example, the data, the incidence, symptoms or object.
4. Used for certain purposes, such as analysis, monitoring or management.

Most of the GIS using the concept of "layer" (layer). Each layer represents a geographic feature in the same area and then all the layers are stacked with each other to get complete information. Each layer can be thought of as a transparent plastic containing only certain images. Users can select the desired transparent-transparent and then superimposed each other so that would be obtained image is a combination of a number of transparent.

B. *Earthquake*

Earthquake / earthquake is a vibration or shock that occurs in the earth's surface due to the release of energy from the sudden that creates seismic waves. Normal earthquakes caused by the movement of the earth's crust (tectonic plates). Frequency region, referring to the type and scale of earthquakes experienced over a period of time.

Earthquakes are measured using observations from seismometers. The moment magnitude is the most common scale on which earthquakes larger than approximately 5 are reported for the entire globe. The more numerous earthquakes smaller than magnitude 5 reported by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter scale. These two scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly almost imperceptible or weak and magnitude 7 and over potentially causes serious damage over larger areas, depending on their depth. The largest earthquakes in historic times have been of magnitude slightly over 9, although there is no limit to the possible magnitude. The most recent large earthquake of magnitude 9.0 or larger was a 9.0 magnitude earthquake in Japan in 2011 (as of October 2012), and it was the largest Japanese earthquake since records began. Intensity of shaking is measured on the modified Mercalli scale. The shallower an earthquake, the more damage to structures it causes, all else being equal.

C. *Google Maps*

Google Maps is a web mapping service application and technology provided by Google, powering many map-based services, including the Google Maps website, Google Ride Finder, Google Transit,[12] and maps embedded on third-party websites via the Google Maps API.[12] It offers street maps and a route planner for traveling by foot, car, bike (beta), or with public transportation. It also includes a locator for urban businesses in numerous countries around the world. Google Maps satellite images are not updated in real time, however, Google adds data to their Primary Database on a regular basis, most of the images are no more than 3 years old.

Like many other Google web applications, Google Maps uses JavaScript extensively.[13] As the user drags the map, the grid squares are downloaded from the server and inserted into the page. When a user searches for a business, the results are downloaded in the background for insertion into the side panel and map; the page is not reloaded. Locations are drawn dynamically by positioning a red pin (composed of several partially transparent PNGs) on top of the map images. A hidden *iFrame* with form submission is used because it preserves browser history. The site also uses JSON for data transfer rather than XML, for performance reasons. These techniques both fall under the broad Ajax umbrella. The result is termed a slippy map[13] and is implemented elsewhere in projects like OpenLayers

III. RESEARCH APPROACH

A. *Requirement Analysis*

The information about natural disaster, especially earthquake, is handled by Meteorology, Climatology and Geophysics (BMKG) Office. BMKG has several agencies in the areas of seismicity which aims to help inform the earthquake in Indonesia. One of the related office is Volcanology and Geological Hazard Mitigation (PVMBG) in Bandung. PVMBG already built a web-based information system about earthquake, which can access through the address http://www.vsi.esdm.go.id.

The web site consist three (3) contents which are about earthquake, the earthquake and map of publication.

The first step in this research is exploring the website and conducting an interview on the Center for Volcanology and Geological Hazard Mitigation (PVMBG). After exploring the existing system we found some problems, such as:

1. The existing website of earthquake could not accommodate all the required information because there are many tools that could not executed.
2. Geospatial data that is not managed properly so that the news delivered incomplete, both in mapping and news content.

3. There is no content mapping in detail is shown with a particular coloration to indicate areas prone to earthquakes are grouped according to the districts in Indonesia.

To resolve this problem, we try to develop new system using GIS technology to create the map of earthquake in Indonesia. The map will display the earthquake information statistically and accompany with some detail information for each earthquake event such as magnitude and the damage caused by earthquake.

The system is expected can provide information to the people and supported by the main contents such as:

1. Breaking news, information about recent earthquake.
2. Maps and Information, information about the region in Indonesia that have experienced earthquakes since 1629-now in spatial format.
3. Each area that have experienced earthquakes is marked with a dot on a map, and the news is displayed bellow.
4. The area which has more frequent earthquake is marked with specific colors.

Spatial data contained on this map was made using GIS quantum. The new system is expected to run better than the previous, its can provide accurate information to the users and can expand for more feature and facility in the future.

B. System Design

Based on requirement that has defined above, we design the system and present it using some diagram such as Data Flow Diagram for process modeling and ER Diagram to present the data model.

The highest level of DFD shows two external entity which involved in this system, Admin as system administrator and the user. The user can be anyone who can access the website. User can view the content, send the comment and read the comment respond. Admin has responsible to keep the data up to date and reply the comment from users.

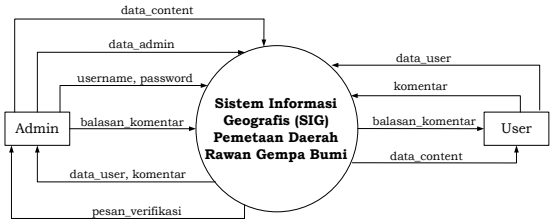

Figure 1. DCD System

As derived process from DCD we define four main process which are manage admin data, manage content, manage shoutbox (comments) and manage the category(of the news). We define the data and the news which entered to the system as the content for simplifying the process.

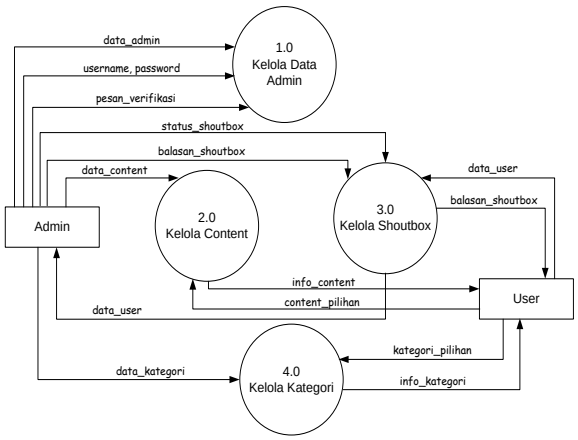

Figure 2. Data Flow Diagram Level 0

Based on data element defined in DFD, we build the data model and present it on ER Diagram as shown on Figure 3. The diagram consists of 6 entities and the earthquake information is put on "titik gempa" or the center of earthquake.

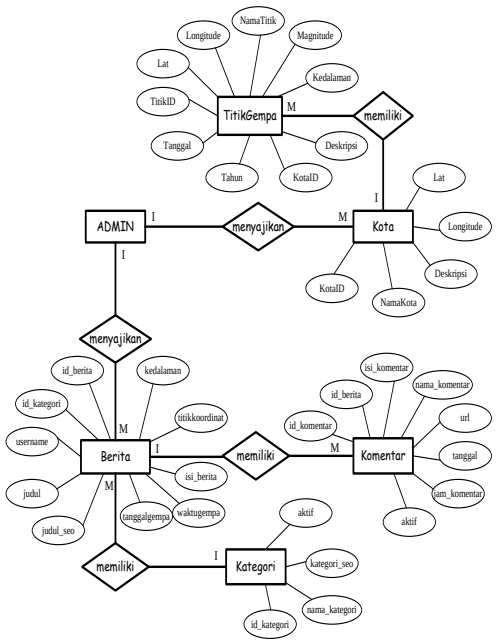

Figure 3 ER Diagram

The next step is transforming the ER Diagram to become the table relationship diagram. To support the system we use 6 table as describe in figure 4.

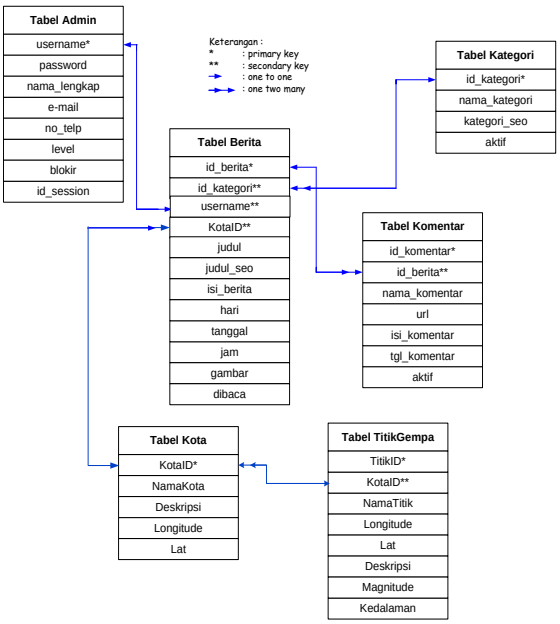

Figure 4 Table Relation

The website was developed using CMS approach so the admin can manage the content easily. As an admin, we can manage the content using main panel as shown in Figure 5

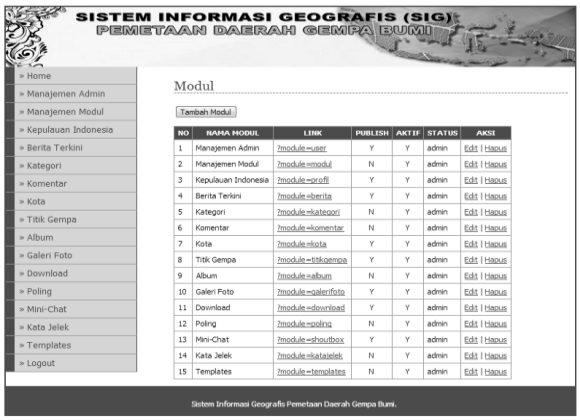

Figure 5. Main Panel for Content Management

Admin can input the earthquake data using the panel as shown in figure 6. The panel shows the city, earthquake epicenter and the impact of earthquake into human or environment

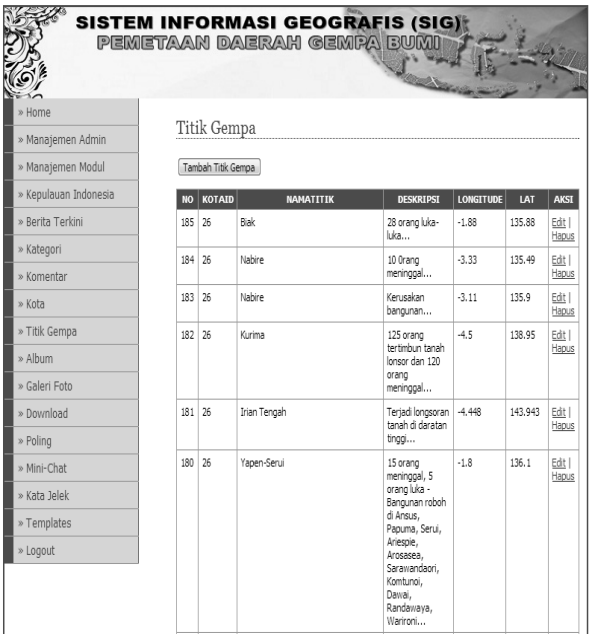

Figure 6. Main Panel for Earthquake Events

Users can see all information in one page that consists of recent news, video, image and comments according to earthquake events (figure 7). Users also can explore more using advanced menu such as display the map, searching the data (figure 8) and download the interest file.

The system also can show the area which has specific range of earthquake event, for example, we classify the area as high risk earthquake prone, middle, and low based on history of earthquake event in the certain area. Figure 9 show the map

Figure 7. Main Menu for Users

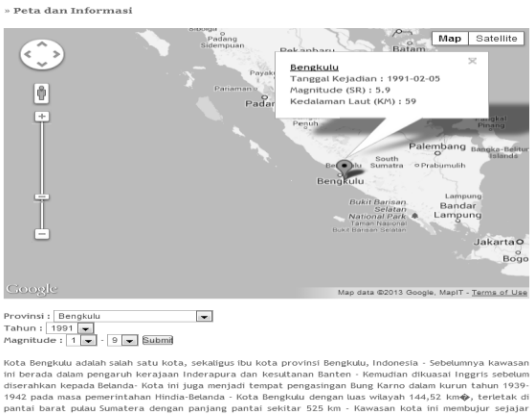

Figure 8. Searching Facility

Figure 9. Map of earthquake region

The data using in this application is entered manually and based on past information. If the system already installed and hosted, we can add some additional features such as connected with earthquake station or detector so the data can update automatically. The system also not include tsunami prediction because of mainly tsunami is caused by high magnitude of earthquake which has epicenter in ocean area. In this application we focused on mapping the area that has more frequent earthquake so the people can make consideration in planning and building the infrastructure in the specific area.

CONCLUSION

Based on implementation of GIS Application in mapping the earthquake prone areas in Indonesia, we can conclude some interesting issue as follow:

1. We can make a Geographic Information Systems (GIS) Mapping Earthquake Prone by using maps that have been digitized and provide features which include the provincial earthquake, year and magnitude , as well as showing seismic area with coloring based on the amount of the number of earthquakes that have occurred in the area.
2. Digitizing the map is done using Quantum GIS to create, store and process spatial data. The data then is stored in MySQL as textual database and using Google Maps API as supported tools to present the spatial data easily.
3. The website can display the information about earthquake more detail because it has news, video and has equipped with searching facility and the earthquake event for each area which categorized based on frequency. It expected to help the user to know which area with high risk of earthquake.

In the future, we can explore and expand the features of this website by adding some integrated data such as data from satellite, completing missed earthquake information, and keeping the data up to date so it can be important reference for the citizen.

REFERENCES

[1] Adam Suseno dan Ricky Agus T., S.T., S.Si, M.M. 2012. Penggunaan *Quantum GIS* Dalam Sistem Informasi Geografis. Bogor: Gunadarma.

[2] Aronoff, Stanley. 1989. Geographic Information System: A Management Perspective. Otawa, Canada: WDL Publications.

[3] Bildirici, I.O, and Ulugtekin, N.N., "Web Mapping With Google Maps Mashup : Overlaying Geodata", A special joint symposium of ISPRS Technical Commission IV & AutoCarto in conjunction with ASPRS/CaGIS 2010 Fall Specialty Conference November 15-19, 2010 Orlando, Florida

[4] Demers, M.N. 1997. *Fundamentals of Geographic Information Systems*. New York: John Wileys dan Sons, Inc.

[5] Gunarto, Thomas Yuni. 2008. *Gempa Bumi*. http://staffsite.gunadarma.ac.id/thomasyg/index.php?stateid=download&id=8195&part=files (akses : 23 Maret 2013).

[6] HM, Jogiyanto 2005. Pengenalan Komputer Dasar Ilmu Komputer Pemrograman, Sistem Informasi. Yogyakarta: Andi.

[7] Pheby. 2012. Bab 2 – Teori Penunjang. http://digilib.its.ac.id/public/ITS-NonDegree-7526-7405040025-bab2.pdf (akses: 25 Maret 2013).

[8] Harsiti. 2009. *Entity Relationship*. http://harsiti09.files.wordpress.com/2009/10/v-entity-relatinal-diagram.doc (akses: 01 September 2013).

[9] Hartono, Jogiyanto . 2005. Pengenalan Komputer Dasar Ilmu Komputer Pemrograman, Sistem Informasi. Yogyakarta: Andi.

[10] Hidayat, Rahmat, dkk. 2005. Geografi dan Koordinat Peta. Bandung : Garis Pergerakan.

[11] Irsyam, Masyhur, et.al, "Development of Seismic Hazard and Risk Maps for New Seismic Building and Infrastructure Codes in Indonesia", Proceeding the 6th Civil Engineering Conference in Asia Region: Embracing the Future through Sustainability.

[12] Malik, Abdullah. 2012. Pengertian, Fungsi dan Jenis Peta. Jepara. URL :

[13] http://farid-rizky.blogspot.com/2012/12/pengertian-fungsi-dan-jenis-peta.html (akses : 05 September 2013).

[14] Mutiarani, Afifi. 2012. Skala Gempa Bumi. Surabaya. URL : http://fiflowers.wordpress.com/geofisika/gempabumi/skala-gempabumi/ (akses : 05 September 2013).

[15] Prahasta, Eddy. 2002. Konsep – konsep Dasar Sistem Informasi Geografis. Bandung : Informatika.

[16] Prihatna, Henky. 2005. Kiat Praktis Menjadi Webmaster Profesional. Jakarta : PT. Elex Media Komputindo.

[17] Rapper J. dan Green N. 01 Maret 1994. *Gis Tutor 2 for Microsoft Windows*. Milton Road, Cambridge CB4, 4ZD, UK: *Longman GeoInformation 307 Cambridge Science Park*.

[18] Sajo, Daud. 2009. Pengertian-Peta. URL : http://geografi-bumi.blogspot.com/2009/09/pengertian-peta.html (akses : 25 Maret 2013).

[19] Setiawan, Dita. 2012. Sistem Informasi Pemetaan Pengungsi Menggunakan *Openlayers Framework*. http://repository.amikom.ac.id/files/Publikasi_06.11.1049.pdf (akses : 23 Maret 2012).