Development of the WebGIS application for transport infrastructure management in the city of Serang

IOP Conf. Series: Materials Science and Engineering **673** (2019) 012072 doi:10.1088/1757-899X/673/1/012072

Development of the WebGIS application for transport infrastructure management in the city of Serang

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Abstract. Congestion has become a common problem in urban. The road growth-rate is always slower than vehicles. City mayor around the world already understands and try to find breakthroughs. Unfortunately, the settlement is often partial and ignore the spatial analysis. This paper seeks to solve urban transport problem in urban with information technology and spatial analysis. The research began with a survey of public transport routes, a review of the transport regulation, one-way road arrangement study followed by WebGIS Development. This application is a multi-tier client-server architecture consisting of the client-side, the server-side, and the data directory that stored in the VPS (Virtual Private Server). The client-side is powered by HTML-5, which is assisted by the API (Application Programming Interface) from several open-source online mapping. Standard performance test of the application has been set, and every menu is well functioned. Every data on the transport infrastructure could be gathered and stored on the web. Furthermore, every transport planning on the city should refer to this transport information system. Thus, WebGIS becomes online surveillance system for land use.

1. Introduction

Integrated traffic and road transportation develop a network of traffic to connect all regions [1]. Concerning transport, the development of road network systems must be guided by the Master Plan of the Road Transport Network according to the needs in the region. The Central Government, Provinces, and Cities have an essential role in the development of the transport system. Their respective authorities require to strengthen and set targets, policy development, controlling and supervising the transport project implementation. Transport needs a derived demand where the movement occurs as a result of activities due to location separation. Thus, the activity system is an integral part of transport planning. Segregation of activities requires network services and movement systems, which is needed to be controlled and coordinated through an institutional arrangement to support the creation of an ideal transport system. Disintegration between subsystems generate inefficiencies in the transport system.

The city of Serang possesses inefficiency of transport. It has reflected by the declining number of public transports, queue problems, parking problems, irregular freight transport trajectories, and the absence of integrated transport-mode. On the other hand, ownership of vehicles, both motorcycles, and

automobiles have increased rapidly in Serang City. According to the Head of Serang Police Traffic Unit (Kasatlantas), in a month, there are ± 4000 motorized vehicles raised in Serang City [1]. This problem is getting worse by the city public transport (called: angkot). These vehicles are usually disobeying the transport-route. Besides that, the identity of the driver is not clear. They also take and bring-down passengers in any place. It triggers severe congestion in several areas in the city of Serang at certain hours. The growth of roads was unable to keep up with the increase in vehicles. Therefore, a comprehensive and structured effort of transport is needed.

2. Urban Transport and Spatial Planning Relationship

Transport is a derivative requirement as a result of the spatial separation that require the movement of people and goods in the social and economic activities of urban communities. All activities require the process of moving people, vehicles, and products, which in transport studies is called "travel." The road network is an infrastructure that becomes a medium for the movement of people, vehicles, and goods from one region to another. Every development of space in urban will always need support from the provision of road infrastructure. In the long run, the provision of road networks will influence the pattern, development of spatial planning, and improve access. It will also provide a boost for the creation of growth activities in each urban. Figure 1 provides an understanding of the interaction between space and the provision of a road urban network.

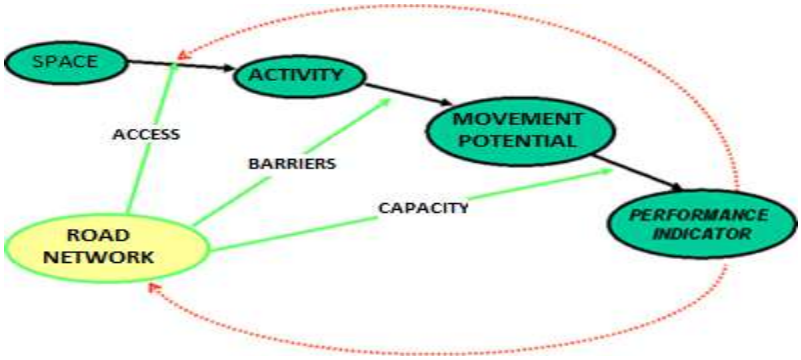

Figure 1. Road Network System for Regional Development.

In the micro transport system, there are several subsystems, i.e., space, activity, potential movement, performance indicators which are strongly influenced by the road network system [2]. The road network system will provide a certain level of accessibility to space in urban. It will enable the occurrence of socio-economic activities on that location. The presence of operations in several spaces raises the potential movement of people, vehicles, & goods to move [3-5].

The existence of space barriers in the form of distance, time, and travel costs determine the potential for movement from one area to another. The road network has a function to reduce the obstacles between spaces so that interactions can occur between areas that have potential to cause the movement. The movement requires space within the road. Therefore the road network must provide adequate capacity so that the flow between areas can be carried out efficiently. The excellent road network performance will support the efficiency of social and economic activities in urban so that the region can develop properly. Transport is a derivative requirement of socio-economic activities in which the need for spatial distribution. All human activities and production processes cannot be conducted in the single location only, so that movement through transport modes is needed. Thus, spatial planning and socio-economic development of the community will significantly influence the pattern and urgency of transport [6-9]. The relationship between spatial planning, travel demand, and transport systems are described in Figure 2.

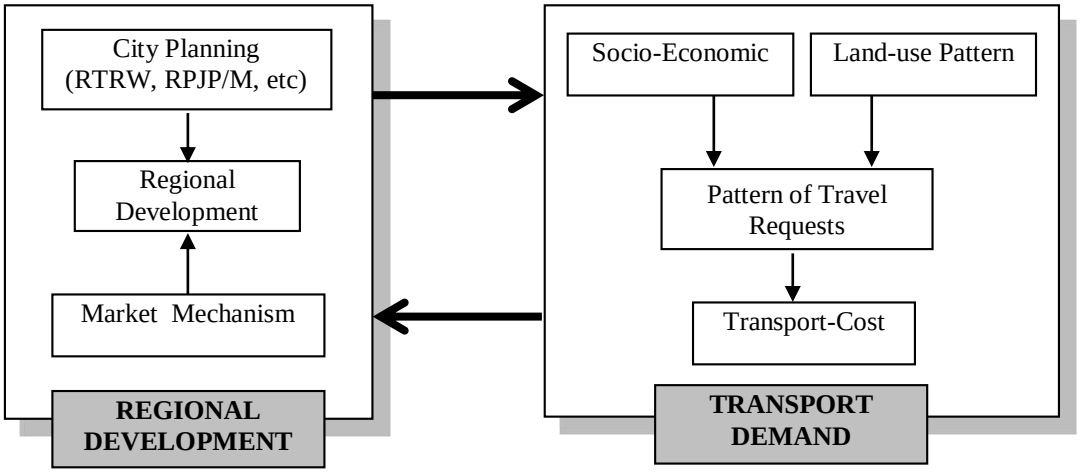

Figure 2. Interaction of Regional Development (Spatial) and Transportation Systems.

3. Research Methodology

Transportation is a derived demand from the movement that occurs as a result of the separation of activity among locations. A geographic information system (GIS) is built to realize integration between subsystems. It presents an analysis of the transport infrastructure in Serang City. Furthermore, a WebGIS is envisioned to optimize the online surveillance system for land use. This research begins with data collection on public transport routes, daily traffic data, and one-way road arrangements. The technique of collecting data is performed qualitatively, i.e., field surveys, literature studies, and questionnaires. A survey was conducted to verify the findings of the hypothesis and cross-checking the literature review. The engineering process of this paper is held by inventing WebGIS, which is a development of preliminary research that reveals transport data using ArcGIS in 2017-2018. This WebGIS is a prototype of the City Serang 1.0 Transport GIS (Geographic Information System) application.

4. Result and Discussion

4.1. Result

Our WebGIS constructed as a multi-tier client-server architecture (Figure 3) that consisting of the client side, the server side and the data directory which stored in the VPS (Virtual Private Server).

4.2. Communication process

The communication process is starting from the client-side. Users send queries or requests to the GeoServer via the internet. The data sent by the user is still in a raster format. Then, the GeoServer takes data form VPS (Virtual Private Server) directory. The SHP (shapefile) data that are stored in the VPS were an infrastructure data which is previously managed by ArcGIS (offline). This type of data is then processed and converted by GeoServer into Raster Images before displaying in the client-side. The GeoServer conduct such a process using Web Map Service (WMS). Ultimately, the result (in a raster format) is sent back to the client-side.

4.3. Server development

The first step of WebGIS installation is to prepare server support from the application that will be built. We chose NGINX as a load balancer that regulates activities, especially when there are many requests from clients. Then, we install TOMCAT Java Server as the backend server. Furthermore, a GeoServer is installed in order to manage all requests from the clients.

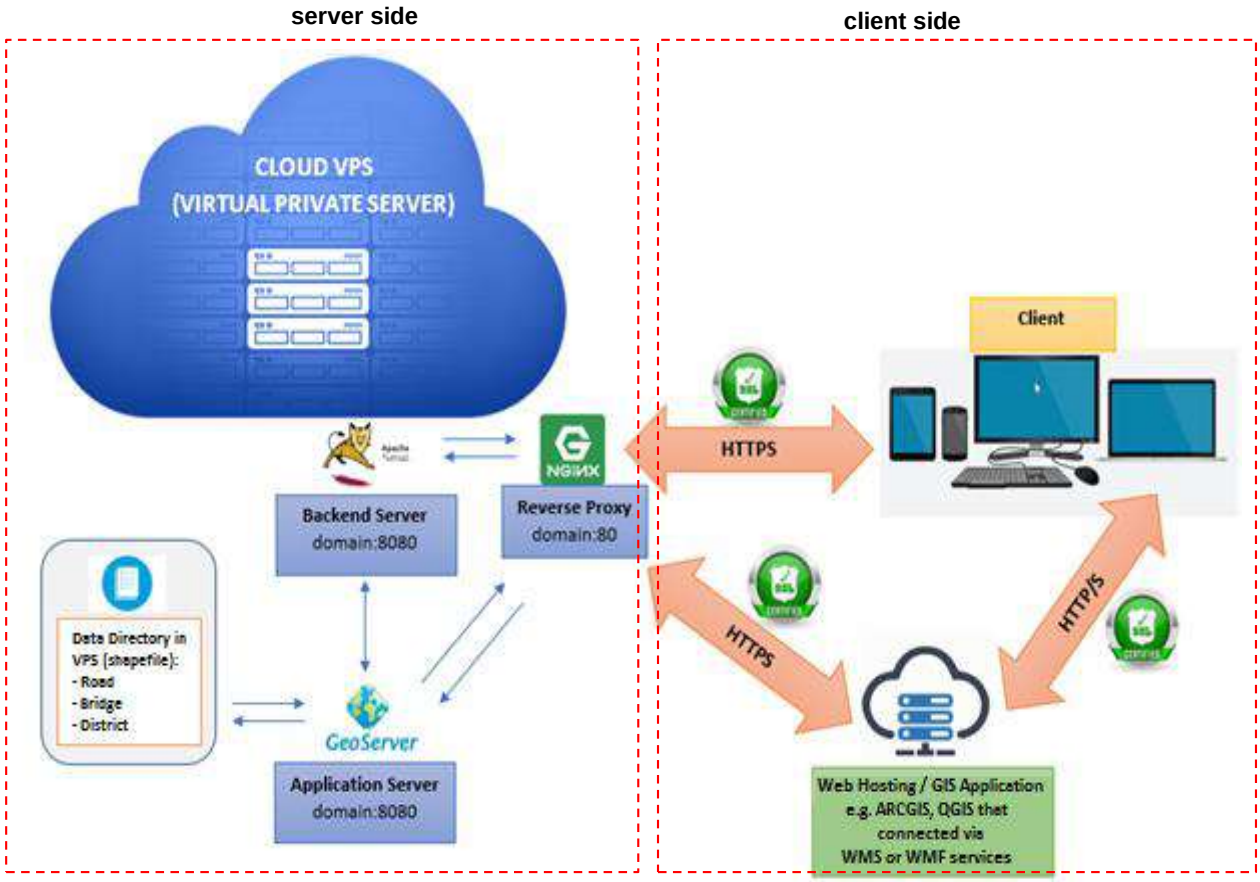

Figure 3. Multi-tier client/server architecture of the WebGIS.

4.4. Interface

Once the server-side installed, then proceed to make the GIS interface on the client-side. This interface powered by HTML-5 which is assisted by the API (Application Programming Interface) from several open source online mapping software such as: 1) Street (ArcGIS), 2) Light gray (ArcGIS), 3) Dark gray (ArcGIS), 4) OpenStreetMap and 5) Bing satellite.

4.5. Performance test

The performance test of this application prototype can be seen from the following detailed specification.

Accessibility

The access could be found from the following URL: *https://web-gis.simanja.org*. It performs as depicted in Figure 4.

Figure 4. Interface of the WebGIS Application: 1) Layer, 2) Menu Bar, 3) Zoom-Control, 4) Geolocate, 5) Bookmarks, 6) Zoom-History

Layering

By default, the map will appear in the administrative boundaries of Serang City without any active layers. Layer activation can be done by checking the list of existing layers. Afterward, the map image will appear on the web (see Figure 5 and Figure 6)

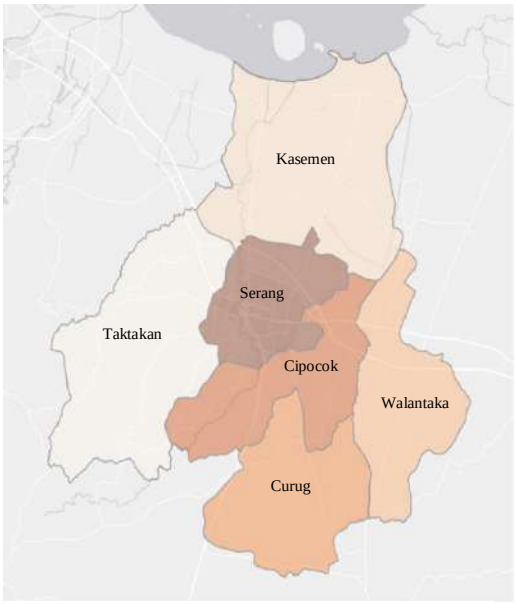

Figure 5. District Layer is activated

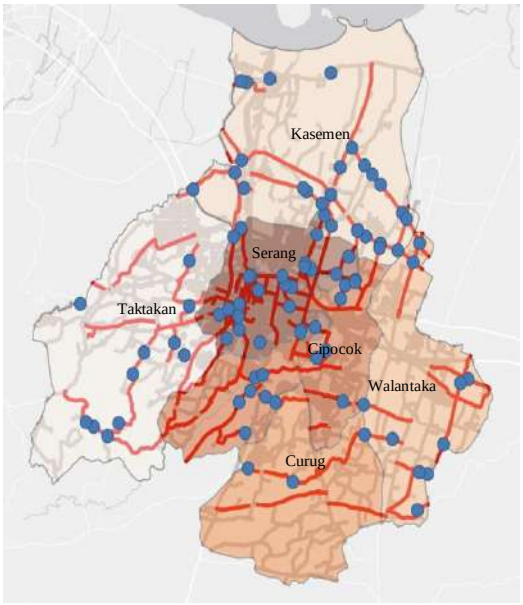

Figure 6. All Layers are activated.

Menu Bar

- About
  Menu-bar serves to display brief information about the WebGIS application and information that contains contacts and metadata from each layer in the list. This information is displayed as a popup.

- Tools
  GIS tools are provided in this menu, i.e. Zoom To Full Extent, Identify Features (Figure 7), Query Widget (Figure 8), Get map coordinates, Share map.

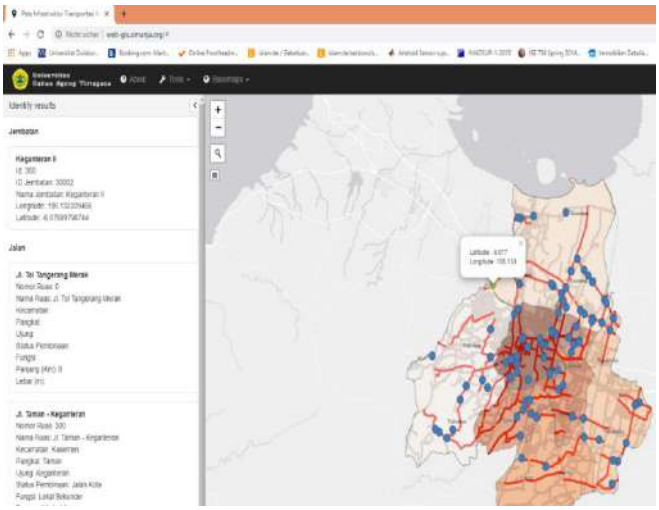

Figure 7. Identify Features.

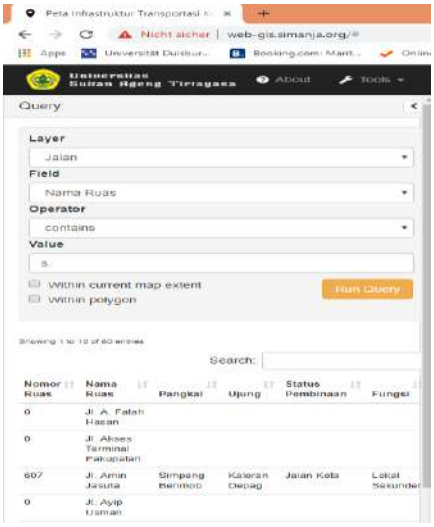

Figure 8. Query Widget.

After the **Identify Features** activated, a window will appear on the left, which contains information according to the selected object / click on the map. The **Query Widget** functions like a geolocate, but in this function, the searching area is specified only for the Bridge Layer (including Bridge Name and Bridge ID) and Road Layer (including Road Name and Road Section Number).

- Basemaps
  Basemaps is a map background which its main content cannot be deactivated, but can be changed as desired. There are 5 Basemaps Modes on this GIS web application, namely: 1) Street (ArcGIS), 2) Light gray (ArcGIS), 3) Dark gray (ArcGIS), 4) OpenStreetMap and 5) Bing satellite.

4.6. Discussion

The road network system can be controlled and supervised using this WebGIS application. Every data on the transport infrastructure could be gathered and stored on the web. Furthermore, every single transport planning should refer to this transport information system. The spatial analysis is then executed, e.g., where the planned bridges are located, how many bridges defect, the status of the road and where the road is located, etc. The WebGIS could also optimize the online surveillance system for land use.

5. Conclusion

WebGIS application for Serang City transport management has been built. This application is a multi-tier client-server architecture consisting of the client-side, the server-side, and the data directory that stored in the VPS (Virtual Private Server). The client-side is powered by HTML-5, which is assisted by the API (Application Programming Interface) from several open-source online mapping. Standard performance test of the application has been set, and every menu is well functioned. Based on the output

of this paper, further research will be performed on WebGIS testing. It should be conducted by several tools such as Jmeter for Geoserver and Selenium Testing Web Apps via Scripting or Record/Playback.

6. References

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