WebGIS Application of Geospatial Technology for Tourist Destination in Malang

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Abstract—**Tourism is a place of relaxation for people in which they can plan their sights based on Information. GIS-based information is increasingly important among tourists as it allows them to get to know places, and this has a deep appeal for travel planning. Malang is a famous tourist destination in Indonesia. The region is visited by a large number of tourists from various parts of the world each year. The number of tourists visiting Malang from year to year is always increasing by considering the number of tourism potential in Malang. However, in the absence of a Tourist Information System, tourists face various difficulties in finding various tourism information. Geospatial technology has changed every area of life and the tourism industry cannot be excluded. The purpose of this research is to develop an interactive and easy-to-use Geographic Information System (GIS) that enables tourists to get information about tourism objects. This research actively demonstrates the potential application of geospatial technology to explore tourist destinations with some detailed information.**

Index Terms—**Geographic Information System; Geospatial Technology; Tourist; WebGIS.**

I. INTRODUCTION

Tourism is an important activity for a country because of its direct effects on the economic, social, cultural, and international sectors. Tourism raises the economic activity through multiplier effects and exploits local culture and nature in a positive way [1]. Tourism has been part of the world's most important economy in the last two centuries. According to the World Tourism Organization (WTO) and World Travel and Tourism Council (WTTC), about 11% of the world's gross domestic product (GDP) is generated by the tourism sector [2]. This definition shows that tourism is interactive; that geography is essentially a very important tourism base; and that it offers an appealing environment for geographers and GIS experts to analyze the various components of tourism in a spatial context [3].

Geographic Information Systems (GIS) are part of the information system and form the chain of survey operations, storage collection, spatial information analysis and production to support decision making [4]. Sustainable tourism is known as a liaison for the development of the world's economic sector as this has attracted the interest of governments, communities and researchers and all of the stakeholders. Those parties have reached an agreement that tourism should be developed in a planned system with the support of Geographic Information Systems (GIS) Decision for its strategy planning. Geographic Information Systems (GIS) integrates hardware, software, and data to capture, manage, analyze, and display all forms of geographically referenced information [5]. Geographic Information Systems (GIS) and tourism have the same characteristics such as the

cross-border disciplines and application areas [6]. According to Dockkey, [4] the potential for GIS applications in tourism is very important. Geographic Information Systems (GIS) facilitates a widely applicable engineering and technology toolbox with the achievement of sustainable tourism promotion and development [7].

The GIS Web is a geographic information system distributed over a computer network to integrate, deploy, and communicate geographical information visually on the World Wide Web (WWW) [8]. In addition, GIS technology can be a valuable tool for answering specific questions related to tourism development including location, regional conditions, trends, and patterns related to the resources [9].

System recommendations and screening techniques according to user preferences have become important research topics and have been developed intensively in recent years. Tourist recommendation system is one of the systems actively researched and developed in the field of Geographic Information System (GIS) [10]. In determining the destination, there are several stages such as choosing tourist types, destinations, tourist attractions, accommodations, etc.

The amount of tourist destination information potentially confuses tourists in determining the sights they want to go according to the criteria they want [11]. Various criteria such as the type of tourist attractions, accessibility, distance, etc. are among the consideration of the tourists in determining the destination that sometimes does not exist on the internet. The internet, in this case, mostly displays only random and unstructured tourist attractions that constrain the tourists in determining the right destination for them.

One of the main problems in choosing tourist location is the lack of information about tourist objects. Therefore, the existence of an information system that can help tourists to look for detailed information is needed. The purpose of this study is to develop web-based applications to determine the category of tourist destinations tailored to the type. In the management of this system, an admin can make additional tourist destination data and edit the existing tourist destinations which then make this system can always be updated in accordance with the circumstances and existing renewals. Thus, a simple GIS web portal was developed for the study to promote tourism facilities that can help travelers to be more effective in accordance with the travelers' convenience. Tourists can easily know the location of the tour along with other facilities from the web portal.

II. RELATED WORK

In recent years, many WebGIS methods have been developed for the tourism sector so that there are some things that can be used as reference for this research. Huang [12] has

developed a prototype of interactive web-based GIS application for the city of Hyderabad to promote its city tour activities and provide users with an innovative way to access the city's spatial content. The research was conducted to develop GIS that enables online interactive guidance for tourists as well as for Hyderabad residents through prototype sites. That was created by using Arc IMS User Interface Developer and HTML for the web page design [13].

This is in contrast with Singh's research [14], Georeference Information Systems (GeoRIST) has been applied in the development of the Agra tourism facility, India for travel communities at international and national levels integrating spatial databases and statistical data with text information to develop data models that can provide actual information and complete analysis and planning.

Tyagi [15] also developed a Web-based Tourism Information System (TIS) for Eastern U.P., built on the GIS platform. This app provides interactive dynamic mapping by showing the location of the tourist destination as well as the location of the Restaurant, travel agent, hospital, security, passport office, tourist office / information bureau, and so forth.

III. STUDY AREA AND MATERIAL

The study area in this research took Malang Raya city area, which covers Batu City, Malang City, and Malang Regency, East Java, Indonesia as shown in Figure 1. The reason for taking the study area in Malang is because Malang has various tourist destinations located in some areas. Besides, Malang is a cultural civilization area marked by many cultural heritage sites that is supported by hilly topography area and cold temperatures in which this makes Malang as one of the tourism destinations in Indonesia.

Figure 1: Study area of Malang

Materials used in this study is obtained from physical data and also a remote sensing satellite imagery. Satellite imagery used is the SRTM (Shuttle Radar Topography Mission) while the remote sensing data is in the form of elevation or earth's surface height. This data is then known as DEM (Digital Elevation Model).

IV. METHODOLOGY AND PROPOSED METHOD

This research methodology can be illustrated as in Figure 2.
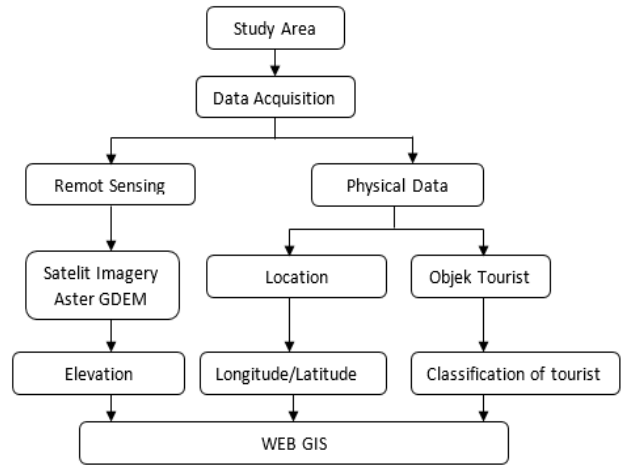

Figure 2: Research methodology

The data acquisition in this study used the first two parameters of remote sensing by using GDEM Aster that is acquired from www.earthexplorer.usgs.gov. From this satellite data, we obtained the information in the form of altitude with the satellite image pixel resolution that is 30 meters. The second parameter is the data of tourism object from the three departments of Culture and Tourism Office in Malang Raya.

From the data of the three related departments, there are 86 tourist objects consisting of four classifications of tourism objects including eco-tourism, nature tourism, artificial tourism, and cultural tourism. The collection of the coordinates of each tourist attraction is collected by using Handheld Global Position System (GPS) by a location survey. So, longitude and latitude of each tourism object are then obtained. Meanwhile, the elevation data in this study is collected through satellite imagery and merged into one so that there is longitude, latitude, and altitude.

V. RESULTS AND SPATIAL ANALYSIS

After the Digital Elevation Model data is processed on Qgis, then the result of its processing can be seen in Figure 3.

Figure 3: Digital Elevation Model

From the data acquisition, the results are modeled in the form of topographic map images. Next, a spatial analysis of topographic map images is done. SRTM has the same data

structure as any other GRID format consisting of cells that each cell has an elevation value. The elevation value at SRTM is the height value of the WGS84 datum. Spatial analysis is done by combining DEM data with the territorial borders of Malang Raya carried out by using Quantum GIS Software where both data have the same coordinates projection which is WGS84 as seen in Figure 4.
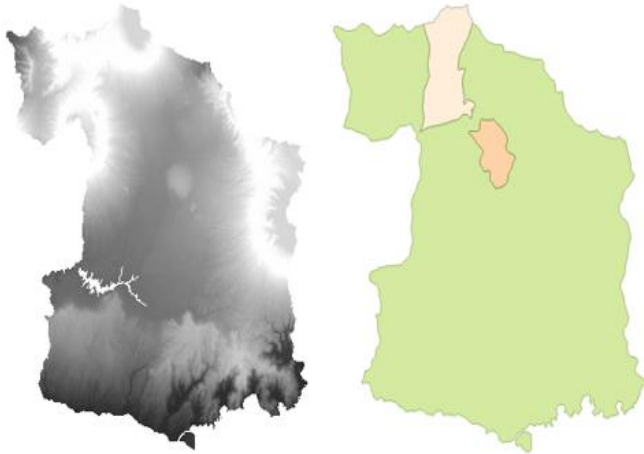

Figure 4: Overlay of DEM data with territorial borders

From the merging results, the analysis between DEM data and Malang territorial borders will yield an elevation value per point or location in all area of Malang Raya, as presented in Figure 5.
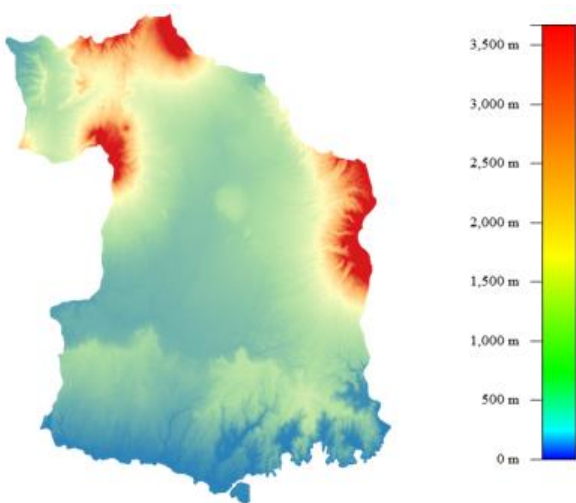

Figure 5: Results of Altitude Classification

In the spatial analysis of Digital Elevation Model, the data in the form of area and also height graphs are then obtained. While Figure 5 illustrates the elevation model data based on the map, Figure 6 shows the graph of the data.
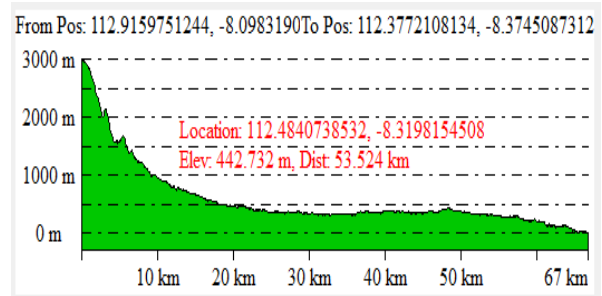

Figure 6: Example of one location with altitude

In the spatial analysis, the height area of each region is obtained. Therefore, the analysis becomes part of spatial analysis by using graphs and also digital maps. The next stage is to convert the data into leaflets and built a web-based geographic information system. This is made to provide a Person Participation in Geographic Information System [9] and is used for tourism maps.

VI. WEB-GIS DEVELOPMENT

The design of Web GIS is depicted in Figure 7.

Figure 7: Web GIS Architecture

The use of tourist coordinates, DEM data, research areas boundaries that are converted by using leaflets is to produce output in the form of digital map visualization. The visualization data is converted into a spatial database that can be accessed through the web server. So, the client can access the data through the web server and can retrieve the existed data on the spatial database. Furthermore, the requested data client is displayed by the web server.

In this system, there are two users who can access and have the access rights. The first is the admin, which works to manage the look and content of the system. The admin has full rights to access the system, including adding, reducing, and updating the tourist locations and other content management. In order to manage the web system, the admin must login first as shown in Figure 8.
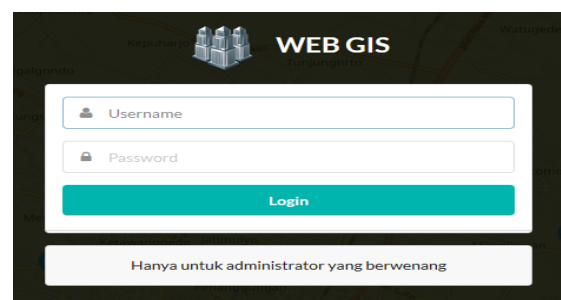

Figure 8: Login Page for Admin

Figure 9: Added page of tourism data

Figure 11: Spatial query using radius

Figure 12: Types of Tourism

After the login is successful, the admin can manage the contents of the web, one of which is to add some data as we can see in Figure 9. Admin can add the data of tourist object, type of tour, latitude, longitude, altitude, ticket price, operational hours, and description along with photos.

The second is the user. The user can only access the start page, do the analysis, choose the type of tour, search for tourist locations, and access information regarding some attraction details.
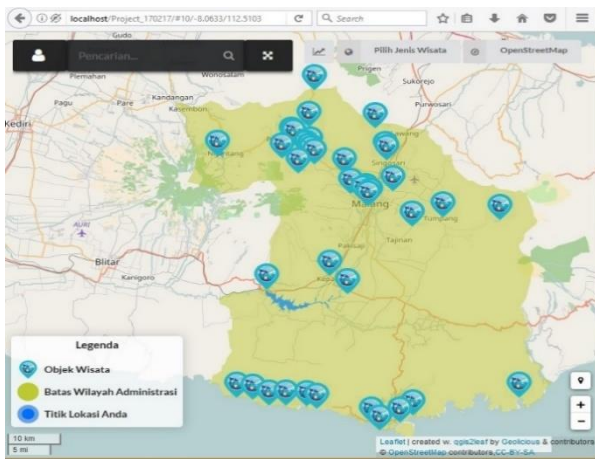

Figure 10: Home Page

There is the initial look of the webGIS in Figure 10. We can access this page by entering the URL in the web browser. In this starting page, there are several features, among others: (1) Spatial Analysis; (2) Type of tourism; (3) Geolocation; (4) Base maps; (5) Search; (6) Chart.

In Figure 11, the spatial query feature is the radius where the feature can be used to know the location of the covered tourist objects from the location that we specify.

In Figure 12, the classification of tourism types is Eco-tourism, nature tourism, cultural tourism, and artificial tourism. If we choose one type of tourism, the object based on the classification will be displayed.
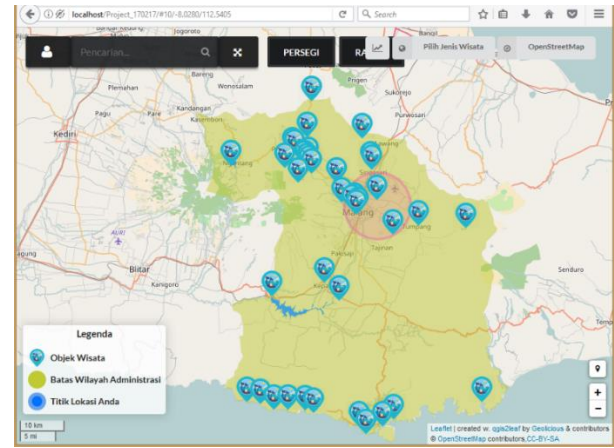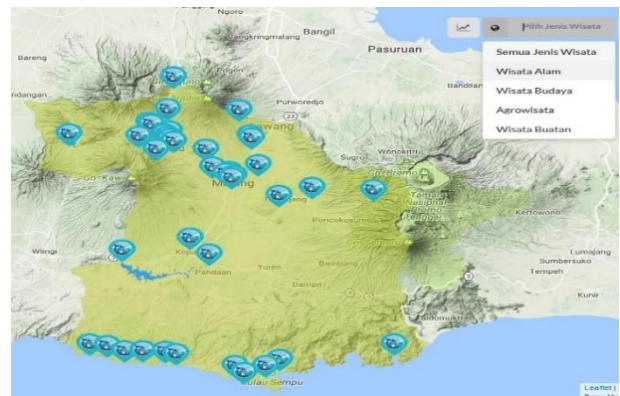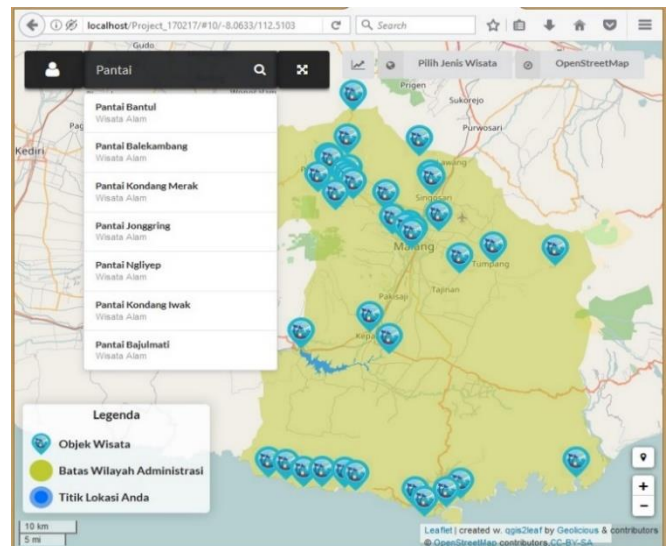

Figure 13: The search for a tourist attraction

In this system, the user can search for tourist attraction in Malang by using the search facility which is provided in the system. The facility also comes with letter detection and data synchronization on the database as shown in Figure 13.
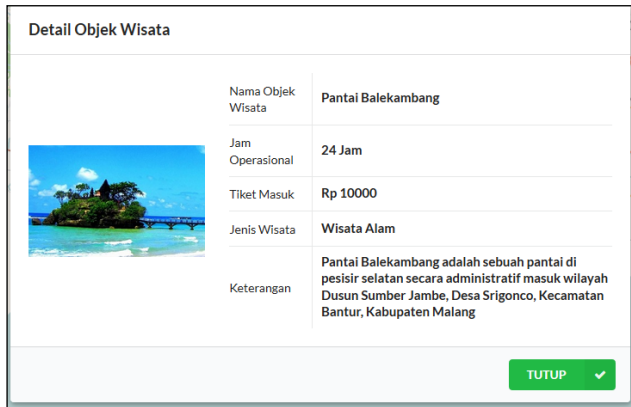
Figure 14: Tourism Object Information Details

We can find detailed information of tourist attractions by choosing one of the existing tourist markers on the base maps. As seen in Figure 14, the detail information is the name of the tourist attractions, operating hours, ticket prices, type of tours, and detailed information about the attraction.

VII. CONCLUSION

The dynamic and interactive GIS-based ways and methods of analyzing spatial data are useful for the exploratory analysis of different dimensions of travel patterns. They allow the researchers, tourists, planners, and administrator to interact, explore, and manipulate spatial and attribute of facilities, natural, and cultural features constituting the tourism products of destination. GIS can help not only to visual nature of tourism products but also facilitate regular changes to any updated information. GIS-based Tourism Information System, in addition, is beneficial for tourists, employers, local governments, and other stakeholders in the decision-making process regarding territorial development and destination management. In this study, an effort has been made to develop an interactive set of data where tourism objects are combined with GIS technology in order to develop tourism information systems for Malang region, that can be easily uploaded on the web for wide publicity of tourism potentials. The proposed Web GIS-based tourism information system will produce an accurate and valuable answer for travelers. The system described in this paper can also be a potential model for developing the WebGIS systems for other areas, such as police departments, health departments, municipal planning departments, and education departments.

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