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Visualization of Road Access Using GIS Based on GNSS Observation at Taman Universiti Parit Raja, Batu Pahat

Siti Hajar Che Mod Nasir[1], Hendy Fitrian Suhandri[1]*

[1]Faculty of Civil Engineering and Built Environment
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, MALAYSIA

*Corresponding Author Designation

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Abstract: Geographic Information System (GIS) is a system of hardware, software and procedures to facilitate the management, manipulation, analysis, modelling, representation and display of geo-referenced data to solve complex problem regarding planning and management of resources. This study will conduct to give knowledge to people and to identify the physical features of the study area such as morphology of the selected route and topography of the area by using QGIS software. The data that can obtain from this software is combination of raster data, vector data and attributes data so from the data the public or authorities can use it freely to develop that area. Authorities and developer also use GIS software to analyses the characteristics of data in any area for development purpose before starting the project. This will help consultant and contractors that involved in the project aware to the situation in map. Application of QGIS can be in order to find the accurate topography and morphology data for the selected area. The use of Google Earth Pro have certain deficiency where the image of the area will not clearly been observed. For point 1 to point 3 the mean for using google earth is 6.611x106 km while the mean by using Leica GNSS receiver is 399.408x106 km. There was difference between Leica GNSS receiver and Google Earth but in order to know more, there need to do more on research about this.

Keywords: Geographic Information System (GIS), Global Navigation Satellite System (GNSS), Raster Data, Vector Data

1. Introduction

According to [1], a Geographic Information System (GIS) is a system of hardware, software and procedures to facilitate the management, manipulation, analysis, modelling, representation and display of geo-referenced data to solve complex problem regarding planning and management of resources. The function of GIS is it can use any information that includes location such as latitude and longitude. There were several types of information can get by using GIS such as data about population, landscape such as location of streams, or different types of soil. In the presence of GIS technology, people can manipulate the locations to discover how can it relate to each other. Example, people can knows about

*Corresponding author: sallehs@uthm.edu.my

water supplies is most at risk, or people can know about the structure of soil. Therefore, this study will conduct to get visualization of road access using GIS software based on Global Navigation Satellite System (GNSS) observation at Taman Universiti Parit Raja area.

Taman Universiti Parit Raja is one of the urbanization region in Batu Pahat. In recent times, a lot of development and construction such as residential areas, buildings and open hall is built where the area has become populated area. Rapid development can cause a problem in route system performance if improper route management is applied. The effects of the developmental transition enhanced the community's well-being as the economy progressed. Essentially, it is too difficult to quantify the well-being of a society or an individual. It is not subtle in any way that can be quantified. There is no technique or method that can fully satisfy human needs in order to reach optimum life well-being. Therefore, this study will conduct to give knowledge to people by using the QGIS software to improve more about route management.

2. Literature Review

Software GIS have taking a huge compliment in intelligent networks. This software are used for multiple purpose and provide an essential platform for data shared by GIS application. In addition to providing important information about research, planning, and real-time decision making; and enabling automatic information generation. The GIS phenomenon itself defines an intelligent network that contains information that can be shared between users.[1]

According to [2], the size of each cell shows raster resolution and is expressed in a linear distance unit or in a degree or percentage of degrees of latitude and longitude (for example the number of feet or metres), kilometres along one cell side of a cell) (e.g., one arc second, or one-third arc second). The raster resolution is a component that controls the storage needs and requires more space in the memory for finer resolutions. This geographical information can be handled in many formats and patterns. A vector data model that holds topological connections between geographic features is one of the most essential formats. These are vectors data from several methods may be derived such as example of analogue map scanning. Firstly, raster forms, then in digital formats forms of vectors.[3] In the concept of vector data, spaces and objects with unambiguous spatial position and boundaries are represented by spaces, lines and polygons. Example of vector data characteristics include, boreholes, drainage rims and structures as polygonal characteristics. [3]

Vector and textual coordinates are used to track the places on the map. This procedure helps produce very accurate cartographic property definitions.[4] The data model, storage method, and spatial index have to be addressed in three areas in order to give a better data collection interface in a large spatial vector data system. In order to adapt the data model to the storage method, a space index will accelerate the efficiency of Big Data recovery.[5] In figures 1 and 2 shows the storage relationship between spatial and attribute data, the vector data model can be classified into a geographical relation and figures big spatial vector data model shows the database vector data model and the database data model should consider new spatial data models.

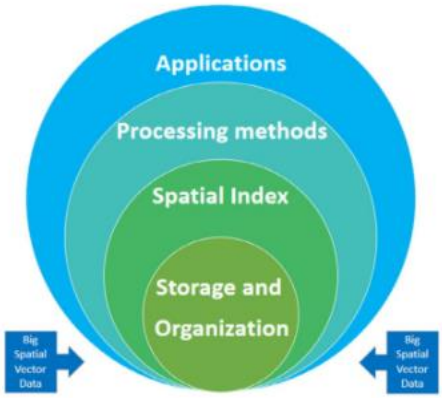


Figure 1: Big spatial data management (Yao & Li., 2018)

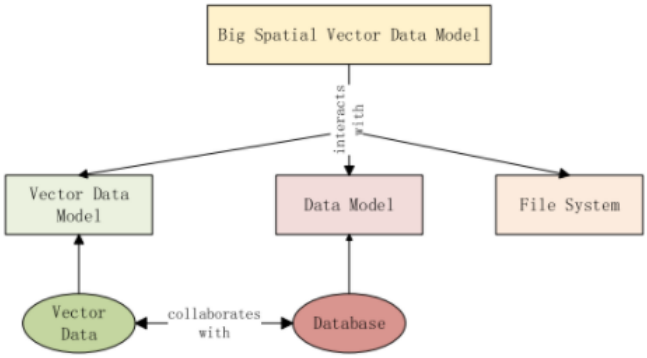


Figure 2: Big spatial vector data model (Yao & Li., 2018)

Attribute data is the second type of data included in the GIS. For example, spatial data might be a county and contain information on town boundaries, census boundaries, streets, etc. A data collection comprising population information may be connected to a map by means of the matching tract value inside the spatial data for each census tract [6]. GIS displays and analyses location-related challenges in geospatial science and natural resource management by integrating various spatial and attribute data and generating information using various spatial analysis tools and modelling modes.[7] This pavilion for geometric geographic characteristics or data is referenced by coordinates and map projections. Over the years, GIS has been applied with 2D mapping to analyze data in vast regions [7]. The information connected to or linked to geographic characteristics is kept in the database for spatial analysis [8]. The geographical information is stored as geometrical entities that possess attributes such as length, starting point and end point via vector data model. GIS vector data is defined by a coordinative sequence and comprises forms such as dots, polylines and polygons [9].

Vector and textual coordinates are used to track the places on the map. This procedure helps produce very accurate cartographic property definitions [4]. Figure 3 shows the procedure for geo-referencing the revised coordinates for the satellite picture rectification.

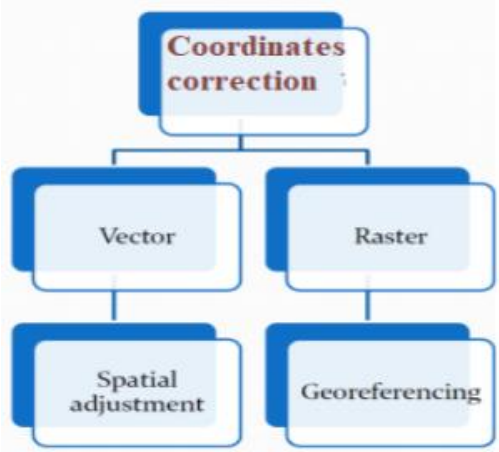


Figure 3: Geo-referencing coordinates (Hamid et al., 2020)

3. Methodology

Flowchart in figure 4 presents the summary of the procedure adopted for this study from start and end of the mapping route in Taman Universiti Parit Raja area. The following diagram shows the flow chart of the study methodology.

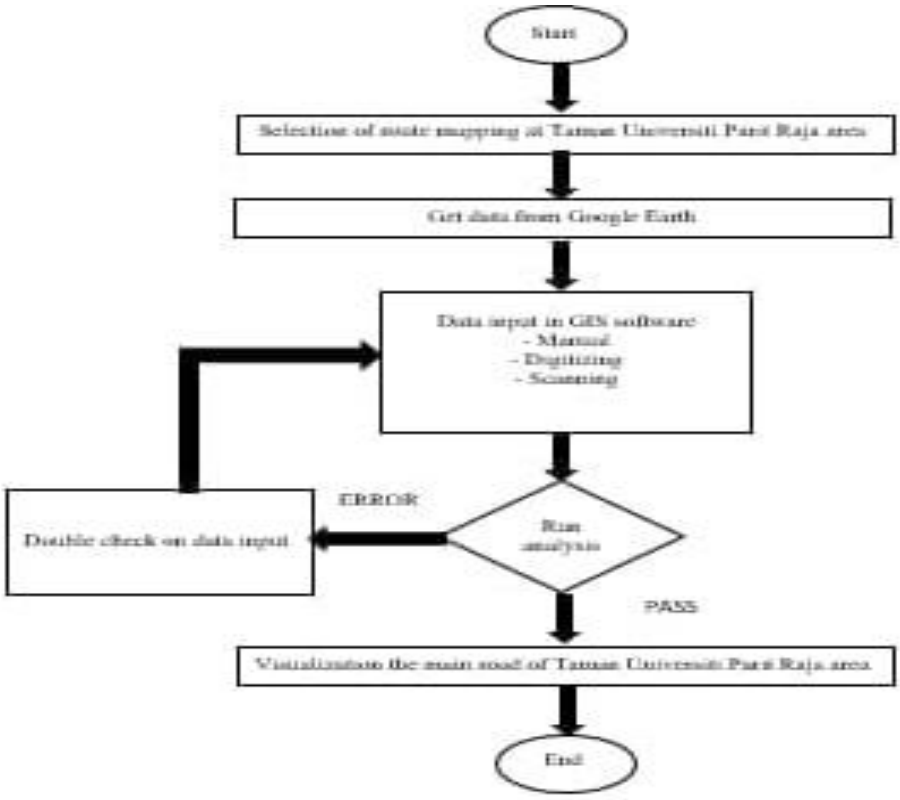


Figure 4: Flowchart

3.2 Selection of route mapping

The study will conduct at Taman Universiti, Parit Raja, Batu Pahat by using GNSS receiver. The project start by determining the location that can be conducted. The location is observed by using Google Earth Pro to obtain the capture of location for use in the location overview. This software can be download via official website. The mapping from this software will be using to adapt into the QGIS software.

Figures 5 shows the location of main route that were choose to conduct which is obtained from the Google Earth. The blue line were label as a route that are choose.

Figure 5: Location of Taman Universiti Parit Raja area

3.3 Get data from Google Earth Pro

The data can obtained from google earth such as area, building and lamp at the conducted study area. The function of Google Earth is to provide search capabilities and the ability to pan, zoom, rotate and tilt the view of the earth. It also offers tools for creating new data and a growing set of layers of data such as terrain, that reside on Google's servers and can be displayed in the view.

Figure 6 Location by using Google Earth

3.4 Data input in QGIS software for visualization main route

This section will explain the step by step to visualize the data. First step is the picture that capture from google earth we add to the function of add raster layer and open in format PNG. As the raster data can see, the next step is add new shapefile layer for the road, building and lamp at study area. For first attribute, the building is shown in polygon such as single-storey house, double storey house, TNB house, open hall and surau were plotted. Second shapefile layer is road, for road the attribute that can

input is road name such Jalan Universiti 9, Jalan Universiti 10, Jalan Universiti 11, Jalan Universiti 12, Jalan Universiti 13, Jalan Universiti 20 and Jalan Universiti 22.

4. Data & Result

4.1 Analysis database from Google Earth Pro

Figure 7 shows the database of GIS from Jabatan Ukur dan Pemetaan Malaysia (JUPEM) and for this study this database was not use in this case study. It is because the database was no longer valid and up to date comparing the data from Google Earth Pro. Therefore, for this analysis, database from Google Earth Pro had been used because it is still valid and the same as the site visit that has been done.

In this study, the QGIS software is a free software and this software also can export the pic in format Joint Photographic Expert Group (JPEG) or Portable Graphics Format (PNG) that can be obtain from screenshot the pic in this format by using Google Earth Pro. This format is a raster format and often used as a photographs. JPEG files are web friendly because the files are typically smaller. It is beneficial to create a Google Maps raster background for the vector data in order to accelerate processing times for big globes. Attempting to construct a globe using only vectors might result in extremely lengthy processing times. For instance, creating an ocean or a big continent entirely from vector data might take weeks or even months. Rather than that, you may construct a simple 2D background using Google Maps raster data in either Mercator or Flat projection, and then add vector layers such as highways, cities, and borders.

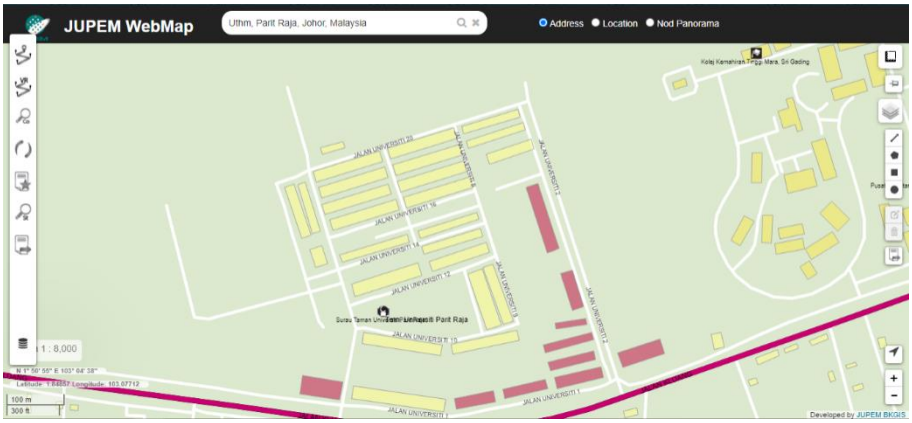


Figure 7: The database GIS from JUPEM

4.2 Analysis database from QGIS

Based on Figure 8, the database that obtain from QGIS software and Google Earth Pro. The yellow dot represent the homestay that exist in that area. There was 8 homestay such as Homestay Ikin Parit Raja, Homestay Mohadniza, Parit Raja Homestay (Nanisha Homestay), Homestay Taman Universiti Parit Raja, Homestay Ain Batu Pahat, Astana Homestay, Homestay Budget bandar Universiti Parit Raja, Warisan Homestay Taman Universiti and 'Bakebylicious'. The blue line that shows in figure 4.1 are the road, there was 21 road name such as Jalan Universiti 9, Jalan Universiti 10, Jalan Universiti 13, Jalan Universiti 14, Jalan Universiti 16, Jalan Universiti 18, Jalan Universiti 20 and Jalan Universiti

22. The width of road is 6 meter and it's a single line road. In this study, thee total length of road is 5359 kilometer. Figure 9 shows the data attributes for selected road at Taman Universiti Parit Raja.

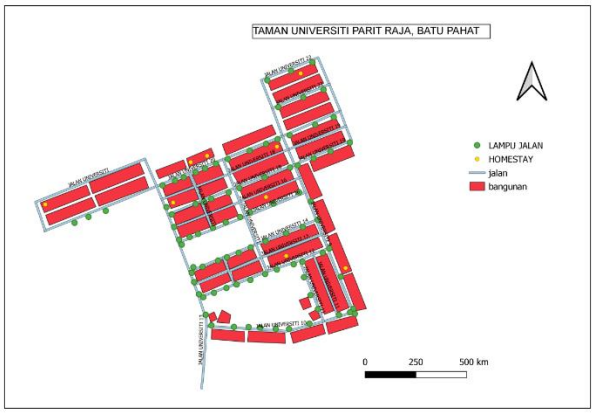


Figure 8: Database in QGIS

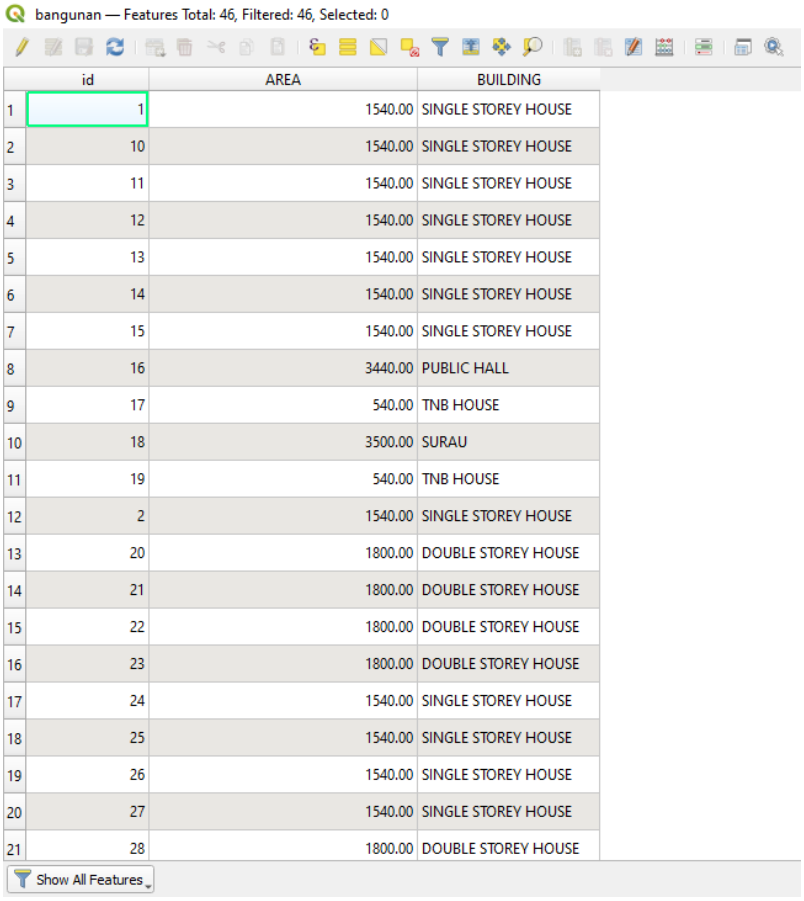
	id	NAMA JALAN	LENGTHROAD
1	9	JALAN UNIVERSITI 22	369
2	10	JALAN UNIVERSITI 13	485
3	11	JALAN UNIVERSITI 12	266
4	12	JALAN UNIVERSITI 12	266
5	13	JALAN UNIVERSITI 14	266
6	14	JALAN UNIVERSITI 16	266
7	15	JALAN UNIVERSITI 16	266
8	16	JALAN UNIVERSITI 18	266
9	17	JALAN UNIVERSITI 18	266
10	18	JALAN UNIVERSITI	235
11	19	JALAN UNIVERSITI	120
12	2	JALAN UNIVERSITI 22	125
13	20	JALAN UNIVERSITI	303
14	21	JALAN UNIVERSITI	60
15	3	JALAN UNIVERSITI 20	649
16	4	JALAN UNIVERSITI 19	172
17	5	JALAN UNIVERSITI 19	129
18	6	JALAN UNIVERSITI 9	314
19	7	JALAN UNIVERSITI 10	292
20	8	JALAN UNIVERSITI 11	121

Figure 9: The attribute data for road

The shape of polygon represent for the buildings in the map. There was consists of 417 units of single storey terrace house, 135 units of double storey terrace house, 2 units of Tenaga Nasional Berhad (TNB) house, 1 units surau and 1 units open hall. Figure 10 shows the attributes data for buildings. The area of each is shown in Table 1.

Table 1: The data for building

No	Buildings	Number of building	Area (square ft)	Area x Number of building (square ft)
1	Single storey terrace house	471	1540	642180
2	Double storey terrace house	135	1800	243000
3	TNB house	2	540	1080
4	Surau	1	3500	3500
5	Open Hall	1	3440	3440


bangunan — Features Total: 46, Filtered: 46, Selected: 0

	id	AREA	BUILDING
1	1	1540.00	SINGLE STOREY HOUSE
2	10	1540.00	SINGLE STOREY HOUSE
3	11	1540.00	SINGLE STOREY HOUSE
4	12	1540.00	SINGLE STOREY HOUSE
5	13	1540.00	SINGLE STOREY HOUSE
6	14	1540.00	SINGLE STOREY HOUSE
7	15	1540.00	SINGLE STOREY HOUSE
8	16	3440.00	PUBLIC HALL
9	17	540.00	TNB HOUSE
10	18	3500.00	SURAU
11	19	540.00	TNB HOUSE
12	2	1540.00	SINGLE STOREY HOUSE
13	20	1800.00	DOUBLE STOREY HOUSE
14	21	1800.00	DOUBLE STOREY HOUSE
15	22	1800.00	DOUBLE STOREY HOUSE
16	23	1800.00	DOUBLE STOREY HOUSE
17	24	1540.00	SINGLE STOREY HOUSE
18	25	1540.00	SINGLE STOREY HOUSE
19	26	1540.00	SINGLE STOREY HOUSE
20	27	1540.00	SINGLE STOREY HOUSE
21	28	1800.00	DOUBLE STOREY HOUSE

Show All Features

Figure 10: The attributes data for building

Based on table 1, the maximum area was controlled by single storey terrace house and minimum area is TNB house. Residential sectors exist outside an administrative city, and are a common characteristic of most major urban environments. It is partially the consequence of the growing population with a vibrant economy attracting migrants. People have now also begun living in lower-density regions and there is now also a trend for smaller and autonomous family units. Industrial development and immigration rush are also accountable for highlighting the issue. Building costs and land prices were too expensive for the medium-sized population to contemplate about buying a home.

4.3 Comparison database by using QGIS based on GNSS observation

From the figure 11 and figure 12, the database from Leica GNSS receiver on Google Maps was not precision. This happens because of the frequency on google maps was not same in Leica receiver. The level of precision necessary while gathering location data varies according on the project being worked on. For certain types of tasks, such as damage assessments, points within ten feet of the damage may be sufficient. Other applications, such as the management of subterranean pipes, require the location to be within a few millimeter of the real position. When a device's location service is used to collect data,

position information can be gathered from a variety of sources, including GPS, cellular, Wi-Fi, or Bluetooth networks. These sources vary in their accuracy, and the device's location service is not always accurate. For individuals collecting data that requires greater precision and dependable quality control, the best solution is often to use a professional-grade or high-accuracy GPS receiver.

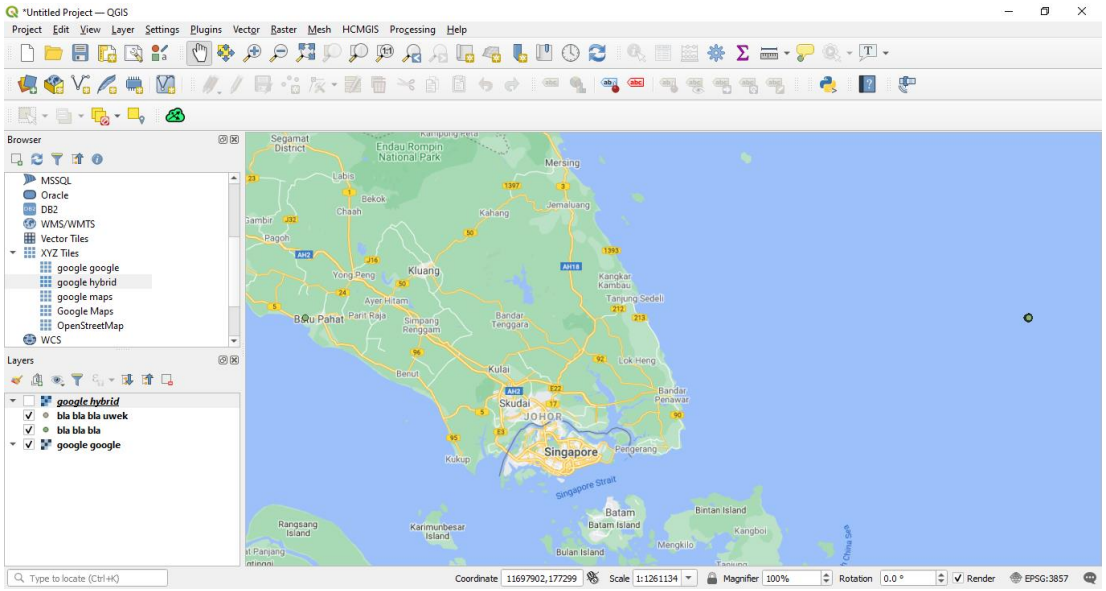


Figure 11: The database from GNSS receiver

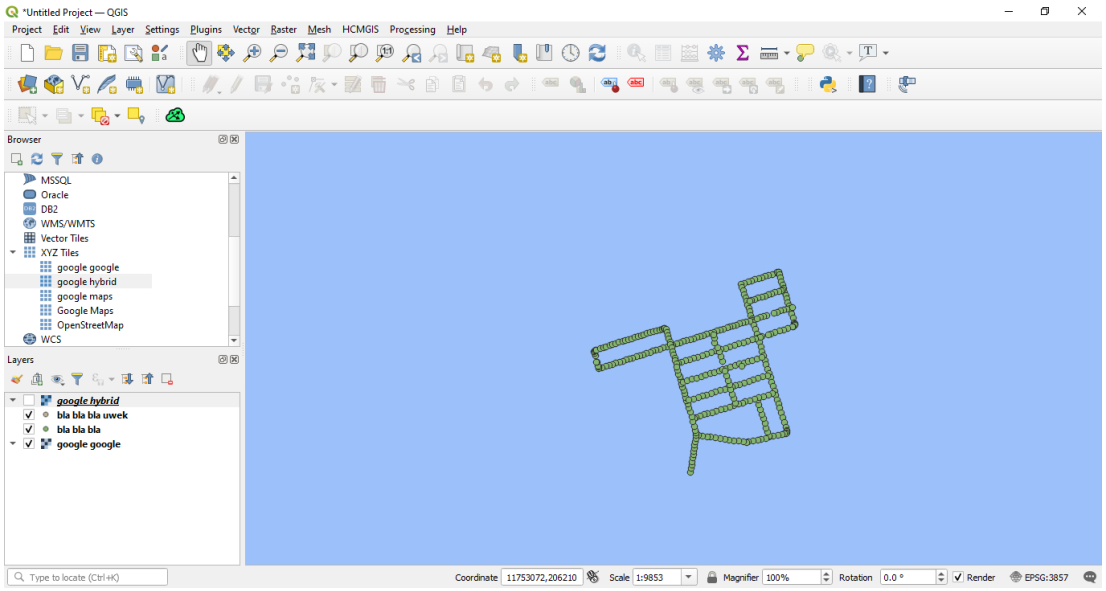


Figure 12: The database for GNSS receiver on Google Maps

Based on the latitude that can obtain with both by Google Earth and Leica GNSS receiver, area was calculated by using formula :-

$$A = 2\pi R^2(1 - \sin lat) \qquad \textbf{Eq 4. 1}$$

which is R is radius of earth the value is 6371km

Table show the area by Google Earth and Leica GNSS receiver by using latitude to calculate. For point 1 to point 3 the mean for using google earth is $6.611x10^6$ km while the mean by using Leica GNSS receiver is $399.408x10^6$ km. There was difference between Leica GNSS receiver and Google Earth but in order to know more, there need to do more on research about this.

Table 2: Area by Google Earth and Leica GNSS receiver

Point	Google Earth (degree)	Area by using Google Earth (km^2)	Leica GNSS receiver (degree)	Area by using Leica GNSS receiver (km^2)
1	103.074135	$6.612x10^6$	564092.6	$372.398x10^6$
2	103.073087	$6.610x10^6$	563969.9	$382.163x10^6$
3	103.073256	$6.610x10^6$	563987.7	$443.662x10^6$

5. Conclusion

In conclusion that based on the raster data, vector data and attribute data that was obtained from Taman Universiti Parit Raja by using QGIS software based on GNSS observation, the following conclusion have been made. It is because the raster data were obtain by using GNSS GPS in Google Earth Pro and combine it with vector data and attribute data. For point 1 to point 3 the mean for using google earth is 6.611x106 km while the mean by using Leica GNSS receiver is 399.408x106 km. There was difference between Leica GNSS receiver and Google Earth but in order to know more, there need to do more on research about this. The combination of raster data, vector data and attributes data the public or authorities can use it freely to develop that area.

Acknowledgement

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