Recent Trends in Civil Engineering and Built Environment Vol. 3 No. 1 (2022) 562-572

RTCEBE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/rtcebe
e-ISSN :2773-5184

Development of Geodatabase of Drainage and Watergate Facilities in Muar

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DOI: https://doi.org/10.30880/rtcebe.2022.03.01.068
Received 4 July 2021; Accepted 13 December 2021; Available online 15 July 2022

Abstract: In respect to social, environmental and economic perspective, flood has been one of the most destructive disaster in Muar. A flood is a situation in which water flows overspill the river channel system. The current drainage system has not been able to accumulate and drain more trends than the standard process. This was due to the tremendous and continuous rain that led to excessive amounts of river water than usual thus overflowing to a lower area. Flood analysis can be greatly helped by using the advanced technology of the Geographic Information System (GIS). Aside from that, a GIS system is a highly strong tool utilized in hydrological engineering to assist engineers and planners in imagining the real-world scenario of flood occurrences, conducting flood analyses, solving problems, and making reasonable, accurate, and effective decisions. The result of database using QGIS with the aid of google earth have been developed. Using QGIS, length of roads and drainage have been determined.

Keywords: Flood, GIS, drainage

1. Introduction

Flooding is one of the most destructive natural hazards that cause damage to both life and property every year. There are many distinct forms of flooding, but river floods, flash floods, coastal floods, and urban floods are the most prominent. There has been an immense interest in the application of Geographic Information System (GIS) to hydrology and water management over the last few years. GIS is a particular technology that is used for the processing of geographic data in order to generate information. The information that is typically collected via GIS comes in the form of a map (topographic map or thematic map), a model, and statistics as well. Spatial data (in the form of geographical reference) and attribute data are used by a GIS (whether in form of writing which brighten the space or attribute). Flooding is caused by heavy rain on the land or when there is a river or stream overflows its artificial or natural banks, inundating the floodplain surrounding it. Floods are repeated phenomena that can occur slowly or gradually, by long rainfall cycles, or else, through unexpected occurrences such as rainstorms very easily.

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According to [1], Muar River Basin is consists of Muar River and several others small tributaries. Muar is home to several famous historical places that commemorate the establishment of Malaysia. Due to this flood, many of the preservation areas have been badly damaged. The location of study area has been selected which is focused in Bakri Muar. Through GIS, the database needed can be obtained accurately as well as having the benefits of the ability to connect the spatial data and non-spatial data. This method is very important in order to reduce flood in Muar happen again in the future. In general, GIS allows users to search for information on specific geographical areas, to analyse spatial information, to edit data and to create maps, charts and reports showing users the results in spatial contexts. It relates to or lives in its entirety and subsequently establishes a database in order to facilitate the process of preparing, evaluating and where necessary, referencing all details. This method can be used to gain database information regarding flash flood in Muar.

The objectives for this paper are to develop a drainage database by using Geographic Information System (GIS), to apply QGIS in determining catchment boundaries in Muar town and to produce database of drainage in Muar in order to simplify the process of editing data and analysing the system.

2. Literature Review

Flood disaster management is a multi-faceted approach that provides a variety of disciplines, including hydrology, management of water supplies, economics, statistics, population studies, public policy and planning. This is due to its impact on the social economic livelihood of the individuals directly and indirectly impacted by it. The following definitions need elaboration in order to understand the essence of floods, their causes and effects such as flood. A flood is an excess of the immense amount of water that submerges the land and causes inundation. Next is disaster. A sudden accident or a natural disaster that causes life to be greatly affected or destroyed. Disasters are either natural or man-made. The purpose of this research is focused on develop and produce the database in Bakri, Muar. Besides, flood happened in Muar are reviewed in accordance to appropriate journals and article. GIS offers a different way of understanding and preparing for each data storage to be carried out in the creation of a database.

2.1 Flood in Muar, Johor

Floods are the most serious catastrophes affecting 4.9 million people and causing damage worth several million each year in Malaysia. The main cause of the flood in Malaysia is the incidence of heavy monsoon or convective rainfall and the resulting high concentration of runoff, which has been worsened by the rapid development of river catchment and the deterioration of river capacity [2]. Malaysia is lucky to have been freed from natural disasters such as earthquakes, typhoons, and volcanoes. In Malaysia, the most severe natural disaster is flooding. Monsoon floods and flash floods are two main forms of floods in this region. The monsoon flood mainly occurs from the Northeast Monsoon, which prevails in the east coast states of the Peninsula, northern part of Sabah, and southern part of Sarawak during the months of November to March with heavy rains.

2.2 Water-Gate

According to [3] the proposed design concerns the field of water gates. In specific, it concerns a water gate made of a flexible membrane for use within a port, canal or river estuary. The Water-Gate uses the weight of the water to stop the water as a rapid, self-deploying barrier. The special nature makes it possible for the water to flow inside the barrier and to automatically deploy itself, stabilising itself on the spot. The portable barrier can be transported to the necessary site by vehicle or smaller barriers are light enough for a person to hold. The Water-Gate can be built by one person, with several lengths and heights available for the barrier, and can be connected together to construct longer sections.

2.3 QGIS

The GIS function can be divided into the key data input and output, storage and data management, and data collection and analysis functions [4]. Databases will be accessible and procured through the Internet and the World Wide Web in greater numbers and details [5]. QGIS is a solution for cloud-based mapping and analysis. Use it to map, analyse information, and share and collaborate. QGIS is a free software program which is user friendly software that can be access by anyone who need it.

2.4 Flood database

Flooding is also described as the overflow of water from the banks - the banks of irrigation or drainage system. It brings destruction. The inadequacy of the current drainage system to handle the volume of rainfall and higher water flow rates causes this problem. The drainage system overflowed as a result of this malfunction [4]. Flash flood occurs because the density of population and densely built-up and paved roads. Rain for two hours is adequate for the occurrence of flash floods. Flash floods happen because of the water has no place to drain since the rivers were in landfills and replaced with drains or smaller drains. Therefore, the quantity of water cannot drain or drain -support by provided [6].

3. Methodology

This chapter discuss about research methodology that compulsory aspects in a research study which had been planned and arranged accordingly to gain the best result. This chapter will begin with the study's aims, which are to generate a spatial geodatabase for future usage in a systematic way in the form of geospatial results. Figure 1 shows the methodology of the study.

Figure 1: Flowchart of Study

3.1 Study area

Muar which is also known as Bandar Maharani is a district in Johor, Malaysia. Muar is situated at the mouth of the Muar River, on the shore of the. Malacca Straits. The Muar District, with a population of 233, 7799 covers 1,354 km² (523 sq mi) (2010). Muar is located at 2°3'N 102°34'E coordinate, near the border of Melaka at north, Segamat at east and Batu Pahat at south. Muar was recently awarded the Asean Clean Tourist City Quality Award 2017 as one of the cleanest cities in South East Asia. Figure 2 shows the location of Muar divided into 12 sub-district namely Bandar Maharani, Parit Bakar, Parit Jawa, Seri Meranti, Sungai Balang, Sungai Terap, Sungai Raya, Jalan Bakri, Ayer Hitam, Jorak, Lenga, and Bukit Kepong.

Figure 2: Location of Muar district

3.2 Data Collection

QGIS is an Open Source Geographic Information System (GIS) licensed under the GNU General. The project's initial objective was to create a GIS data viewer. Its current features include viewing, editing, sophisticated geoprocessing, and a variety of analytic options. A plugin is distributed through the QGIS official repository, which allows developers to contribute their work. Users of QGIS may find it and install on their computers by using the QGIS plugin management.

3.2.1 GIS Data

Spatial data is a phrase used to express any data relating to or containing information about a particular position on the Earth's surface, generally well known as geospatial data. Spatial data may obtain in diversity of styles and includes more than just location-specific data. There are a few main words that will helps become more comprehend in the contact of spatial data in order to better understand and learn more about spatial data which is vector, raster and attribute. Non-spatial data also known as attribute or characteristic data is an information that unconstrained of all geometric considerations. Schedule information can be stored as a table in folders or databases, text files, database queries and so on. QGIS empower to load spatial and non-spatial layers. This actually includes tables supported by Simple Features Library and delimited text. Non-spatial tables can be explored and edited using the attribute table view as shown in figure 3.

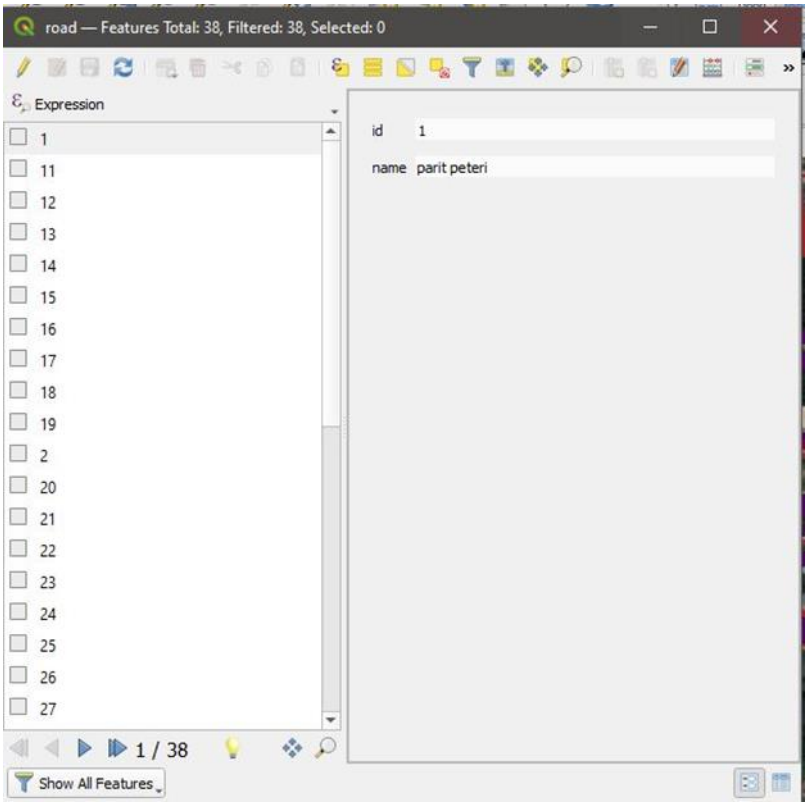

Figure 3: Attribute table for region layer

3.3 Database Modelling

Three category of data models are primarily available: conceptual data models, logical data models and physical data models, and each has a particular definition. The data models are used to represent the information and how it is processed in the database and to determine the relationship between items of data. Firstly, conceptual data model is a data model characterize the structure as for contain and the range of the model. Usually, it just involves the key ideas and the main connections between them. This is typically a first-cut model with inadequate information to create an actual database. This level defines the entire database layout for a set of users. The conceptual model is often referred as the data model that can be utilized when a database system is introduced to determine the conceptual schema. Secondly, logical data model. Logical data models or logical schema incarnate the abstract structure of a knowledge domain. This is in reverse to a conceptual data model, which specifies an organization's semantics without relation to technology. The logical data model may become the basis of a physical data model and form the design of a database until validated and accepted

3.4 Spatial Analysis

In the matter of arithmetic's and geometry, locational analysis, spatial analysis is a type of geographical analysis that pursue to describe patterns of human behaviour and its spatial expression. The actual capability of GIS is the proficiency to perform analysis. Spatial analysis is a method to which geographically model problems, generate results through computer processing, explore and test those results. For specific purposes, this type of analysis has certified to be highly effective in assessing the geographic suitability of certain locations, evaluating and anticipating results, interpreting and understanding changes, detecting significant patterns hidden in your data, and much more.

4. Result Analysis and Discussion

This chapter will amplify on the implementation of the methodology by using the collection data from variety of sources. This topic will start by the database in Muar, Johor. Next, it will be pursued by the process and geo processing technique for selecting the site location for the study area. Concluding the result, the location of study area will be appeared.

4.1 Drainage Design Criteria

The drains are meant to collect surplus rainwater created as surface runoff from metropolitan areas transport it, and then release it to outfalls. Drain design entails hydrological estimates of runoff from the drainage basin, as well as hydraulic computations of the drain section based on the hydrologic computations. The size and type of the catchment area, as well as the intensity of rainfall, its frequency of occurrence, and duration, are all factors in runoff computation.

4.2 Drainage Parameter

The map was taken from google earth. Figure 4 displays the site location with chainage at Mukim Bakri, Muar Johor. The chainage started with CH0 and end with CH1990. Table 1 shows the parameter of the chainage.

Figure 4: Selected chainage in Mukim Bakri, Muar Johor

Table 1: Parameter of Chainage in Mukim Bakri, Muar Johor.

No.	Chainage	Width (m)	Coordinate	Type
1	CH0	0	2° 1'54.60"N 102°38'54.20"E	EARTH DRAINAGE
2	CH61	4.3	2° 1'56.30"N 102°38'54.40"E	EARTH DRAINAGE
3	CH381	1.4	2° 2'6.90"N 102°38'53.90"E	EARTH DRAINAGE
4	CH460	6.1	2° 2'8.10"N 102°38'52.30"E	EARTH DRAINAGE
5	CH773	4.8	2° 2'11.20"N 102°38'42.50"E	EARTH DRAINAGE
6	CH963	4.8	2° 2'13.10"N 102°38'36.60"E	EARTH DRAINAGE
7	CH1026	4.8	2° 2'13.40"N 102°38'34.70"E	EARTH DRAINAGE
8	CH1199	3.1	2° 2'14.50"N 102°38'29.10"E	EARTH DRAINAGE

9	CH1285 J1	9.7	2° 2'12.50"N 102°38'28.70"E	EARTH DRAINAGE
10	CH1334 J2	5.1	2° 2'18.00"N 102°38'28.50"E	EARTH DRAINAGE
11	CH1465	4.6	2° 2'22.30"N 102°38'28.90"E	EARTH DRAINAGE
12	CH1585	5.45	2° 2'26.10"N 102°38'29.00"E	EARTH DRAINAGE
13	CH1990	15	2° 2'39.20"N 102°38'30.10"E	EARTH DRAINAGE

4.3 Design Phase

The selection area at Mukim Bakri, Muar Johor. Bakri is actually a populous town located at Batu 6, Jalan Bakri Muar. It is located at latitude 2° 3'N and longitude 102° 40'T. Figure 5 presents the selection area from google earth. After added the raster layer, the shapefile layer was added to form the database map before it been edited and analyzed. The spatial data consists of building, road and lamp post. Purple colour represent the buildings, red colour stand for road and lamp post colour is yellow. In the shapefile layer, there are three types of geometric which are polygon, line and point that has been used in this studied.

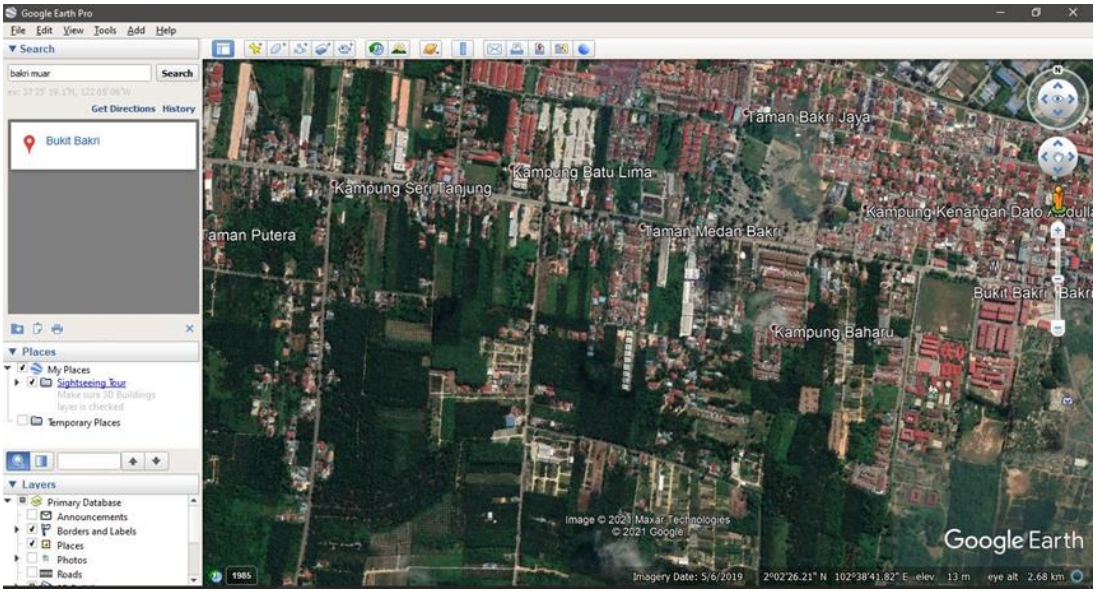

Figure 5: Mukim Bakri from Google Earth

4.4 Analysis Phase

The database of drainage in Mukim Bakri Muar displays in Figure 6. In the study area, there are four legend in the map which are building, road, lamp post and drainage. Refer to Table 1 for the characteristic of drainage. There are several designs of drainage system in residential areas which are surface, subsurface, slope and downspout/gutters. Flash flood occurs when an ineffective of the drainage system design at the cities or residential areas. Maintenance for the drainage system and on-site detention can be done in order to reduce of flash flood in the urbanized areas. The quantity of buildings in the studied area are 106 as shown in Figure 7.

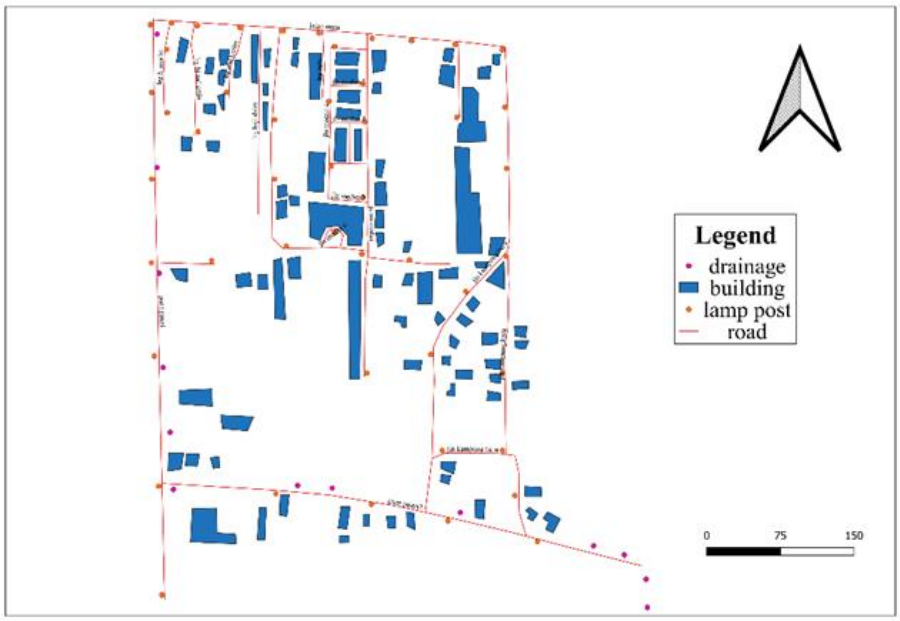

Figure 6: Database of drainage in Bakri, Muar

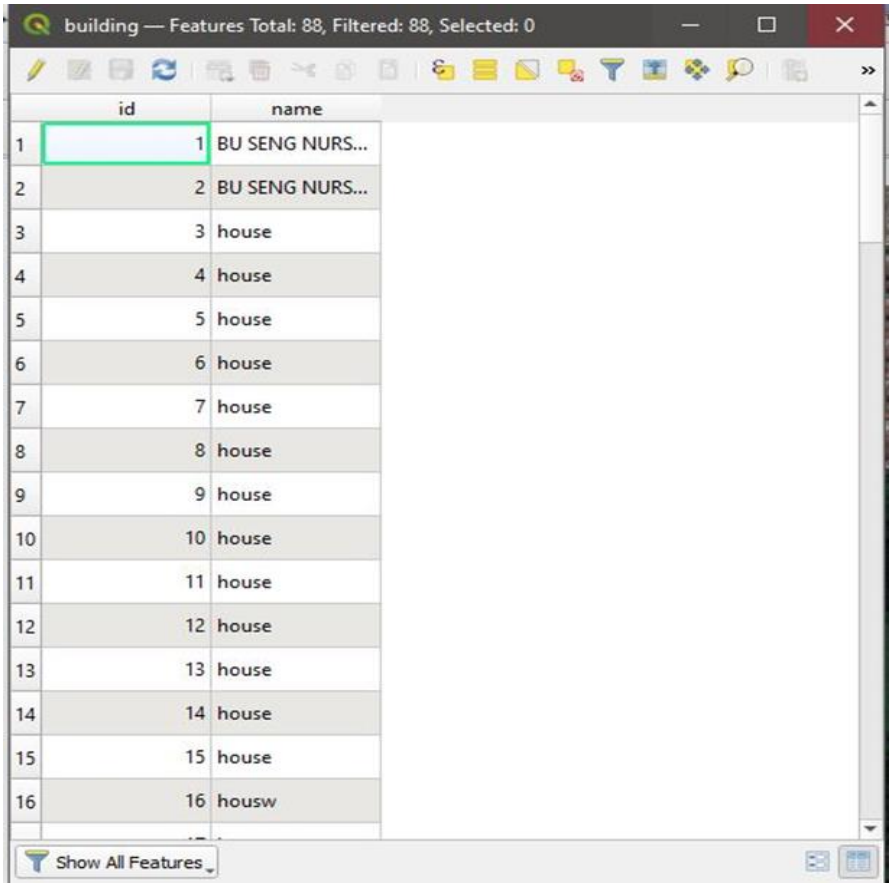

Figure 7: Attributes tables for buildings

4.4.1 Length of road and drainage

The road in the selected area consists of main road and secondary road. Table 2 below shown the length of road that have been measured while Table 3 array the length of drainage.

Table 2: Length of selected road

No.	Name	Distance (m)
1.	Parit Peteri 1	755.0
2.	Parit Peteri 2	840.5
3.	Lorong Haji Modat	126.23
4.	Lorong Haji Md Amin	215.88
5.	Lorong Haji Daim	338.7
6.	Jalan Medan 1	362.76
7.	Jalan Medan	572.35
8.	Jalan Medan 2	60.22
9.	Jalan Medan 3	55.57
10.	Jalan Medan 4	60.39
11.	Jalan Medan 5	69.61
12.	Jalan Medan 6	81.56
13.	Jalan Kampung Baru	830.85
14.	Jalan Kampung Baru	483.85
15.	Jalan Muar	601.50

Table 3: Length of drainage

No.	Name	Length (m)
1.	CH 61	13
2.	CH 381	15
3.	CH 460	12
4.	CH 773	16.5
5.	CH 963	12.4
6.	CH1026	13
7.	CH 1199	10.6
8.	CH 1285	10.7
9.	CH 1334	14.3
10.	CH 1465	11.5
11.	CH 1585	14
12.	CH 1990	14

4.4.2 Quantity of water drain

When extensive drainage planning and design of each section of an urban environment is carried out, it is discovered that man-made structures have a significant impact on storm water runoff behaviour. The organized system of natural drainage lines is replaced by a system of roof and property drains, inlet, channels and pipes when residential development occurs in a natural catchment. Planning

and designing an integrated drainage network for a new development requires a database such as catchment natural drainage direction, runoff outfall point, catchment boundary and catchment sub areas.

4.4.3 Relationship between database and Google Earth drainage

Database from QGIS can be a guideline for flood database as it can produce watershed for the flow drainage for further use. The database might be slightly accurate due to human error during developing or gaining the data from an open source such as coordinates and images. However, the database still relevant and can be referred.

The database comprises a variety of datasets that, when integrated, create a rich and comprehensive testing landscape for a variety of applications. The database were gain from the same source which is Google Earth. Using the watershed delineation boundaries, the drainage areas were established. Estimated watershed contours were constructed using Google Earth. Hence, flood disaster in Bakri, Muar can be resolve.

5. Conclusion

In relation to the debate and analysis that has implemented, it can be determined that the study's aims along with objectives indicated in Chapter 1 have been complied. From the analysis that has been made, the database was completely gained from google earth and QGIS. The database model created in this research can be used to assess the process of determining the drainage database at the location on a regular basis.

Besides, GIS will aid to personalize the info for the area because GIS feature is highly generic and extensive, the data will be incorporated into the software and encourage knowledge changes in the futures. This analysis will be able to picture the data, which was before simply data, and then the data can be easily assessed by reference to the spatial map. This GIS programme allows to track the data enter rapidly as the selected area can be retrieved in order to see the condition and consequences appropriately and efficiently. The future of open source GIS (especially QGIS) is expected to be bright, as its performance continues to improve and become more precise (with the addition of new features on a regular basis).

As a result, the use of tools in the study has several limitations, resulting in the outcomes generated being used just as a starting point. This database should be able to modify and present the data in a more effective and compulsive method. Besides, map taken from google earth may not be accurate because of print screen layout. Nothing in the form of a polyline is accepted by this QGIS; instead, everything must be in the form of a polygon. As a result, the shape of the building on the spatial maps was inaccurate due to the use of a polygon shape rather than a polyline shape.

Acknowledgement

The authors would also like to thank the Faculty of Civil Engineering and Built Environment, Universiti Tun Hussein Onn Malaysia for its support.

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