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ROYAL MAUSOLEUM AS HERITAGE TOURISM IN VIRTUAL REALITY USING GEOSPATIAL INFORMATION SYSTEMS (GIS) OF PERAK TENGAH DISTRICT

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ABSTRACT

Perak Tengah District has the potential to benefit from heritage tourism. The main problem there is no tourism database for the royal mausoleums in Perak Tengah District for heritage tourism. The aim of develop tourism trails of royal mausoleums in Perak Tengah presented in the Virtual Reality (VR) using Geospatial Information Systems (GIS) with three objectives which are (i) to identify tourism trails of Royal Mausoleums in Perak Tengah district, (ii) to evaluates the adequacy of support facilities and conditions of heritage tourism and (iii) to recommend VR using GIS as new contemporary forms of technology. The study begins by identifying secondary data determining the description and history of royal mausoleums in Perak Tengah. Observation survey will be used in this study as qualitative research, which to identify mausoleums in the Perak Tengah District and the evaluations the adequacy of support facilities and infrastructures. A software *QGIS* are used to locate and mapping the distribution of mausoleums in Perak Tengah District. According to the findings, 16 mausoleums and 1 museum of *Kompleks Sejarah Pasir Salak* have been located within the study area. By using coordinates made up of graphic data, the results of the identification of the distribution of tourism products are projected on a map and *Google Earth*. In the findings, 16 mausoleums adequate with support

facilities and infrastructure especially road access, signages and wayfinding. The further studies should consider and investigation of components a VR and GIS that would help local authorities or stakeholders take advantage of this technology for promotion tools.

Keywords: Geospatial Information Systems (GIS), Heritage Tourism, Royal Mausoleums Virtual Reality (VR)

INTRODUCTION

Heritage tourism is described by UNESCO as monuments like architectural creations, monumental sculptures, and paintings, as well as groups of buildings that have exceptional universal value from the perspectives of history, art, or science, as well as sites or archaeological sites. Perak Sultanates started from the 16th to the 19th century AD, the tombs and royal palace were always situated on the eastern bank of the Perak River which are including Perak Tengah Districts. Based on previous research in 2010, there are 11 of royal mausoleums founded in Perak Tengah (Suprayitno, 2010).

The recent creation of *GeoPusara* mobile application a database for the recording of death and grave information shows the potentials for researching and creating database for royal mausoleums acknowledging heritage tourism in Perak Tengah. There are 259 tourism products in Perak Tengah including the royal tombs that rarely exploited (Isa et al., 2022).

The problems of the lack of a proper recording system in royal mausoleum in Perak Tengah leads due to the challenge in locating the tombs plot. The only references to determine the tomb location are by the caretaker, local people or museum curator (Noradila et al., 2021). A well-organized method is needed for storing data that can map tomb plots and then be used as a reference and preservation management. Consequently, reliant on GIS's benefits. This study aimed to develop a GIS tourism database integrated with VR to promotes tourism trails of royal mausoleums in Perak Tengah. The objectives of this study are:

1. To identify tourism trails of Royal Mausoleums is a for heritage tourism in Perak Tengah district.
2. To evaluates the adequacy of support facilities and conditions of heritage tourism.
3. To recommended VR using GIS as new contemporary forms of technology to promotes the heritage for Malay Royal Mausoleums in Perak Tengah Districts

This research's noteworthy contribution for tourism in Malaysia.to produce a framework-on Virtual Reality by using the Geographical Information System (GIS). The research gap of this study is the VR components should include for heritage of royal mausoleums to represent heritage in realistic virtual environments where the public can immerse and interact with these artifacts.

LITERATURE REVIEW

Gis Database and Virtual Reality Technology

Geospatial Information System (GIS) technology in tourism is considered as a database and mapping technology dealing with geographic data. It is a structured collection of computer hardware, software, and geographic information that enables users to store, manage, alter, analyse, and present spatial geographic data to produce meaningful information for decision-making. Each piece of data has a spatial representation in GIS. Data can be presented visually and simply using GIS. GIS offers customers a dependable tool for interacting with various spatial data (layers). The layers of geographic information can also be easily linked to other attribute tables, including databases for spatial data properties. The link is an interaction between the database and the digital map, hence any change to the map will immediately update the database and conversely (Salim et al., 2022).

Definitions of VR differ due to the efforts to explain the various features that are deemed necessary to create a virtual reality experience (Çizel & Ajanović, 2018). The main goal of virtual heritage is to represent cultural heritage in realistic virtual environments where the public can immerse and/or interact with these artifacts. Virtual heritage directly involves computer graphics and/or multimedia content, 3D objects, 2D images, sounds, music (Cecotti, 2022). Tourists are increasingly seeking information that intensely reflects a destination. For tourists, navigating tourism information systems can be a difficult and time-consuming task. Tourists cannot experience a tourism product before visiting the destination in just using querying and comparing the spatial data in GIS and 2D maps. VR is a prevailing tool in overcoming the limits of tourism’s intangibility since consumers could experience tourist attractions or destinations in advance of their visit (Kim et al., 2020).

VR in Heritage Tourism

Virtual reality technology can establish three-dimensional digital model for material cultural heritage to record real and accurate shape information and texture information. The researchers can use the three-dimensional model to measure and analyse the cultural heritage, analyse the details of the cultural relics without direct contact with the cultural relics, assist the research work; visitors can observe the details of the cultural relics from various angles in the virtual scene through virtual display and other techniques. The visit process is no longer restricted by the time and space of the exhibition. In this way, people's understanding of cultural relics is increased while reducing physical contact. VR can be used as a unique platform for providing more of necessary information of places and objects that are of interest for the tourist in the area they visit, as well as a research tool (Cecotti, 2022)

Heritage sites that are virtually accessible are constantly being added to the list. Many pieces of cultural material from many societies and tourist places throughout the world have been digitally preserved. Cultural heritage locations

and artefacts can be digitally captured or turned into virtual 3D representations utilising 3D scanning technology (Cecotti, 2022). Due to their efficiency in terms of both cost and time, as well as their ability to store highly accurate data sets indefinitely, such models can be a useful tool for protecting cultural heritage. A cultural heritage site or object may experience consequences like erosion, but a VR model can give accurate details about its prior appearance, monitor the degree of damage, or help with restoration planning. Additionally, it can help with monitoring or picturing the results of future reparative measures. (Guttentag, 2010; Zhong et al., 2021).

The promotion of cultural heritage is greatly aided by VR when it is used at amusement parks and other tourist destinations. For instance, visitors may be able to virtually tour Antalya's renowned Phaselis National Park. Visitors can digitally explore the tangible and intangible cultural legacy of this historic city through simulations. VR's marketing potential can be utilised at tourist destinations like museums and historic sites (Cecotti, 2022; Griffin et al., 2015; Guttentag, 2010).

METHODOLOGY

Study Area

The district of Perak Tengah is in the centre of the Perak State. Seri Iskandar is a main town and under jurisdiction Perak Tengah District Council. There are 12 mukims in total. Perak Tengah District was selected because of the historical and heritages assets and many tombs situated on the eastern bank of the Perak River in Perak Tengah District. The data needed can be achieved effectively and this study becomes very beneficial for tourism development in Perak state (Refer Figure 1 Study Area).

Research Framework

Research methodology of the study is shown in Figure 2, there are 5 main steps used in the study. The preliminary study covers the initial part of this destination before any development is made. The preliminary study includes identifying the problem statement on its definition, proposing aim and objectives as well as the scope of the study.

Then, secondary data collection-based map and mausoleums in Perak Tengah are available on the online media .The data were processed based on the names of mausoleums, the districts mausoleums are located, the history of previous sultanates and lastly the coordinates like latitude and longitude that can place mark or position on a map. The observation survey are used to evaluates the facilities and infrastructures provided at mausoleums.

Data validation refers to the process of checking the accuracy and quality of the data source. The data are from different sources, consistent, accurate and complete to prevent data loss and errors during the process. The data validation

method used in this study is establishes a stakeholder by identifying the person in charge of each administrative area, official websites and museum curators.

After that, The map collects data from the environment through technology through survey by using QGIS software. The map is then interpreted by decoding the symbols on the map. Lastly, QGIS software used to manage the information stored in the database. By using this software, the data for this study can be manipulated according to the need for mapping purposes in line with the aims and objectives of this research. To create an interactive database of mausoleums in Perak Tengah. (Refer Figure 2 Research Framework)

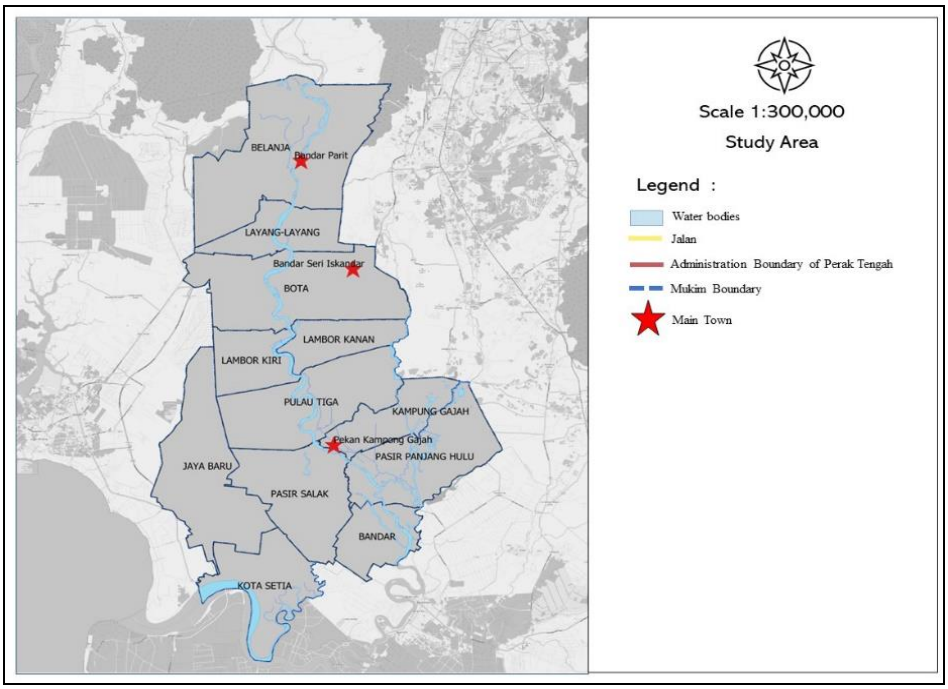


Figure 1: Study Area

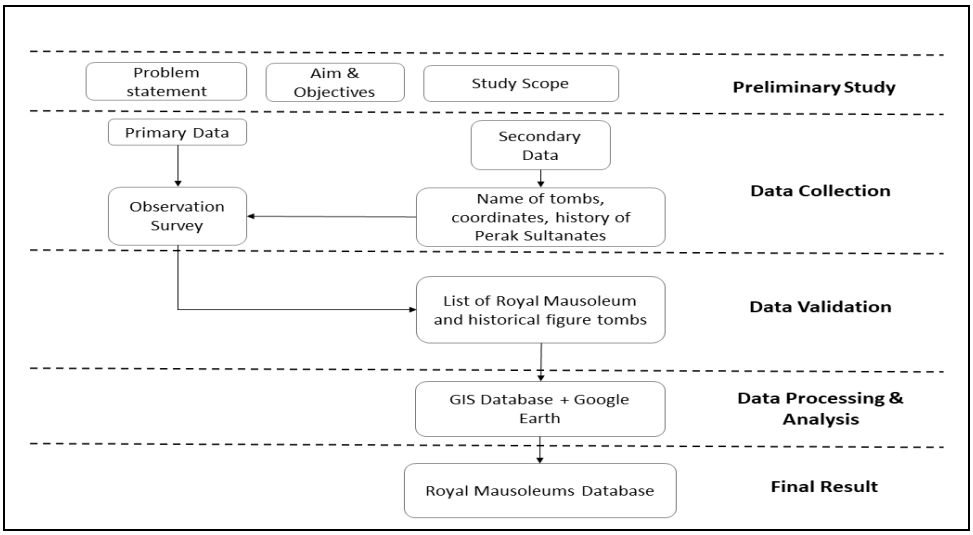


Figure 2: Research Framework

RESULT AND DISCUSSION

Identification Of Royal Mausoleums In Perak Tengah District

Based on observations, there are 16 coordinate points of mausoleums and 1 museum had been discovered. In addition, the noteable figure in historic for Perak Tengah included. Most of the mausoleum's locations at the east bank of Sungai Perak (Refer to Table 1 The list of mausoleums).

Facilities And Infrastructures To Support Tourism Heritage Products

The observation survey involved of 4 elements which are signage and wayfinding, accessibility of tourism, condition of mausoleums and support facilities that including parking. Most of the mausoleums supported by infrastructure in the form of roads to locations and the conditions provide comfort for tourist. To obtain the desired information, each information at the mausoleums is manually recorded by written, each volunteer is provided with a hard copy of the mausoleums list and survey forms for data collection. They also use mobile phones if necessary to take pictures and videos of the mausoleums in case they missed any information.

Table 1: The List of Mausoleums

No	Coordinates X, Y	Name	Mukim	History
1	MultiPoint ((100.90769286065057031 4.30614356764011674))	Makam Sultan Muzaffar Shah I	Lambor	The 1st Sultan of Perak (1528 - 1549)
2	MultiPoint 4.1732850242597985, 100.94638387381191	Makam Sipuntum	Kampung Gajah	Malay Warrior
3	MultiPoint 4.1207945110255775, 100.99081273803577	Kubur J.W.W. Birch	Kampung Gajah	Perak's Residents
4	MultiPoint 4.476029127078157, 100.90875598545435	Makan Ngah Sagor	Belanja	Malay warrior/ Parit
5	MultiPoint 4.507353,100.921637	Makam Almarhum Tepus Raja Sulong	Belanja	Royal heir
6	MultiPoint ((100.88224949624618887 4.35394013796021984))	Makam Sultan Muzaffar Shah III	Bota	The 13th Sultan of Perak (1728 - 1752)
7	MultiPoint ((100.89476434527932724 4.32796684409629773))	Makam Sultan Muzaffar Shah II	Bota	The 10th Sultan of Perak (1636 - 1653)
8	MultiPoint ((100.88391672859570747 4.34999443756430537))	Makam Sultan Alauddin Shah & Sultan Ahmaduddin Shah	Bota	The 5th Sultan of Perak (1594 – 1603 and the 18th Sultan of Perak (1786 - 1806)

9	MultiPoint ((100.98519643297508708 4.13342914010974916))	Makam Sultan Mahmud Shah ibni Almrhum Sultan Muhammad Shah	Pulau Tiga	The 8th Sultan of Perak (1627 - 1630)
10	MultiPoint ((100.94725861000000577 4.17300238999999973))	Kompleks Sejarah Pasir Salak	Pasir Salak	Museum of Malay warrior
11	MultiPoint ((100.99438845712651869 4.11747307742495927))	Makam Sultan Abdul Malik Shah	Bandar	The 19th Sultan of Perak (1806 -1825)
12	MultiPoint ((100.92482517056120628 4.18822596940931557))	Makam Megat Terawis	Kampong Gajah	Bendahara of Perak
13	MultiPoint ((100.9240592195336319 4.2285932112861051))	Makam Sultan Muhammad Syah Ibni Almarhum Raja Mansur Shah	Kampung Gajah	The 14th Sultan of Perak (1744 – 1750)
14	MultiPoint ((100.92351540661532283 4.19274465366847959))	Makam Sultan Ahmad Tajuddin Shah Marhum Muda	Pulau Tiga	The 3rd Sultan of Perak (1577 - 1584)
15	MultiPoint (4.165046176620746, 100.97022540503814)	Makam Puteri Limau Purut	Pulau Tiga	Princess of Acheh
16	MultiPoint 4.157687302126184, 100.97504608949453	Makam Sultan Abdullah Muazzam Shah	Pasir Panjang Ulu	The 20th Sultan of Perak (1825 - 1830)
17	MultiPoint 4.157687302126184, 100.97504608949453	Makam Sultan Jaafar Muazzam Shah	Pasir Panjang Ulu	The 23rd Sultan of Perak (1857 - 1865)

Source: Author,2022

Signage And Wayfinding

Signage and wayfinding are evaluated for three factors, the availability, clearness of the words and the distances of signages. Based on the observations, the products shown a satisfactory in terms the provision of signages. However, there are that the signages in these tourism areas are seriously need attention and acts from local agencies. The sizes and clearness of small signages usually become the issues. The Signage and Wayfinding must be readable at least 300m from the drivers to locates the locations.

Figure 3: The signages is in satisfactory condition and readable

Figure 4: The size and fonts of signages too small

Accessibility

The mausoleum supported by infrastructure in the form of roads to locations that are good enough. Most of the mausoleums can be access less than 5 Minutes from main road to entrances and the road access are in good conditions. Some of the mausoleum is under private property, however the road access can be used for public. Meanwhile, other mausoleums are located at cemetery areas.

Figure 5: Road access to Makam Sultan Muzaffar II and Makam Almarhum Tepus Raja Sulong

Figure 6: Road access to Makam Sultan Muzaffar II and Makam Almarhum Tepus Raja Sulong

Condition of Mausoleums

The condition of the product place also shows a very good environmental condition. Only several are in bad condition. The buildings at mausoleums preserved and not degraded as rural areas are not physically impacts with development. As the cleanliness of tourism areas based on the visibility of litters in the areas are not impact the physical and visual degradation of the environment.

Support Facilities

The parking areas are provided to public. As some of the mausoleums are located at the private property areas, the public can park in the areas. Meanwhile, the area such as commercial and cemetery areas are provided with parking facilities. Table 2 below shows summary of observation results of each mausoleum in Perak Tengah District. The statements show that each of them has a different strength and weaknesses in terms of signages, accessibility, condition, and support facilities.

Table 2: Summary of observation survey

No	Places	Signage	Accessibility	Condition	Support facilities
1	Makam Sultan Muzaffar Shah I	Good	Good. The mausoleum is in the private property but can be access.	The building of mausoleums preserved and conditions is good enough to be visited. .	Good
2	Makam Sipuntum	Good	Good	Good	Good
3	Kubur J.W.W. Birch	No signages available.	No road access, mausoleum is under private property, but can be access.	Good.	No parking provided.
4	Makam Ngah Sagor	Good	Good	As it placed near to commercial areas, the litters can be visibles.	Good
5	Makam Almarhum Tepus Raja Sulong	Good	Good	Good	Good

6	Makam Sultan Muzaffar Shah III	Good	Good	Good	Good
7	Makam Sultan Muzaffar Shah II	Good	Good	Good	Good
8	Makam Sultan Alauddin Shah & Sultan Ahmaduddin Shah	Good	Good	Good	Good
9	Makam Sultan Mahmud Shah ibni Almrhum Sultan Muhammad Shah	Good	Good	Good	Good
10	Kompleks Sejarah Pasir Salak	Good	Good	Good	Good
11	Makam Sultan Abdul Malik Shah	Good	Good	Good	Good
12	Makam Megat Terawis	The size and font too small from 300m	Good	Good	Good
13	Makam Sultan Muhammad Syah Ibni Almarhum Raja Mansur Shah	Good	Good	Good	Good
14	Makam Sultan Ahmad Tajuddin Shah Marhum Muda	Good	Good	Good	Good
15	Makam Puteri Limau Purut	Good	No proper access road. However the public could access.	Not good. Too old and no maintainance.	Not Good, no parking provided.
16	Makam Sultan	Good	Good	Good	Good

	Abdullah Muazzam Shah				
17	Makam Sultan Jaafar Muazzam Shah	Good	Good	Good	Good

Source: Author,2022

GIS Mausoleums In Perak Tengah Database

The taking of the coordinates of the distribution of mausoleums was carried out in several mukim in Perak Tengah District by secondary data on Google Earth recorded on 2021 and Google Maps 2021, and list of royal mausoleums in Perak Tengah District in Pejabat D.Y.M.M Paduka Seri Sultan Perak Officials websites that listed and explaining the previous Perak Sultanate. However, the websites had no mapping systems projected the mausoleums.

The mausolems are recorded in excel then tranferring into attributes table in QGIS. Mobile phones or camera used to take pictures and videos of the mausoleums to be recorded and stored in the GIS Mausoleums database. The point is used to plot the mausoleums as the mark for coordinates. In the attributes table, the information data had been stored such as name of mausoleums, pictures,videos,location and condition. The Id number is used as a guide to connect the plot points to the attribute data. Refer to Figure 7 Attribute Tables of Royal Mausoleums.

The GIS application developed based on the methodology consists of an interactive map that displays the location points of mausoleums with videos and pictures. The development of spatial data starts with acquisition of the district or region maps for base map in GIS. Then, layer model, which includes layers such as roads, buildings, vegetation, watercourses to integrate database.The coordinate points are combined, data visualization is carried out through the QGIS application which is then carried out a map layout so that it can display each mausoleums on the Map Refer to Figure 8 Mapping of mausoleums in Perak Tengah in 2D.

1.2 fid_1 = ε

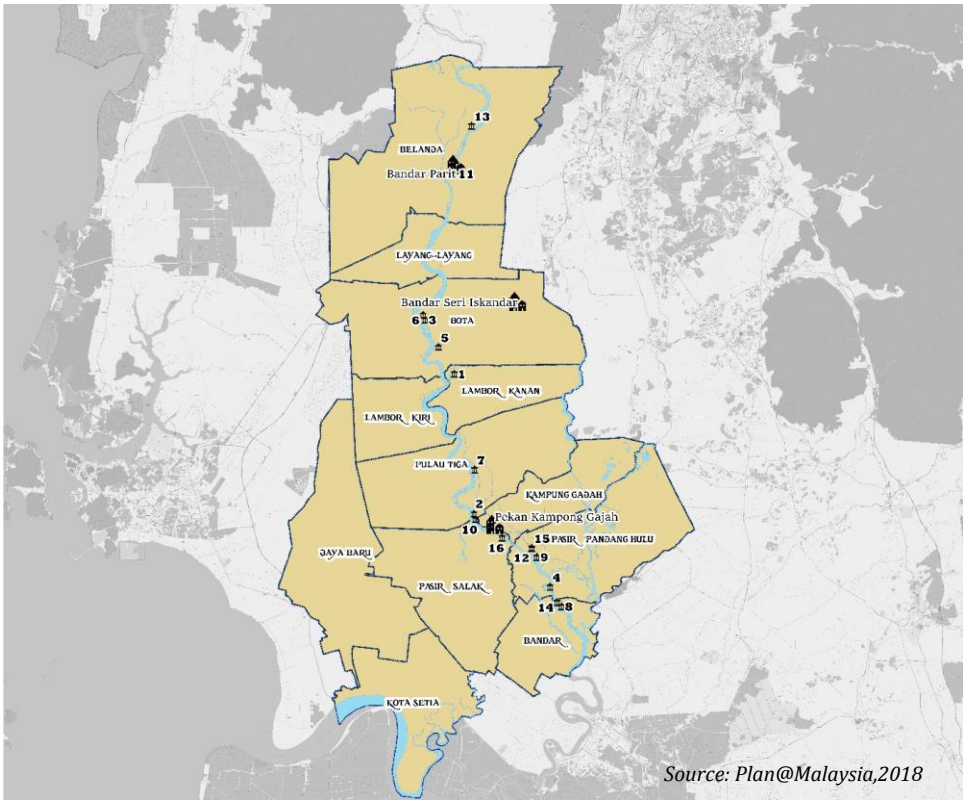
	fid_1	id	Nama	Jenis	Tarikan	Gambar	BP	Video
1	1	1067....	Makam Sultan Muzaffar Shah III	Royal Tomb	Warisan	1067_Makam S...	Bota	NULL
2	6.0...	1068....	Makam Sultan Alauddin Shah & Sultan Ahmaduddin Shah	Royal Tomb	Warisan	1068_Makam S...	Bota	NULL
3	7.0...	1069....	Makam Sultan Muzaffar Shah I	Royal Tomb	Warisan	NULL	Lambor Kanan	NULL
4	8.0...	1070....	Makam Sultan Muzaffar Shah II	Royal Tomb	Warisan	1070_Makam_S...	Bota	NULL
5	10....	1072....	Makam Sultan Mahmud Shah ibni Almrhum Sultan Muhammad Shah	Royal Tomb	Warisan	1072_ Makam S...	Pasir Panjang H...	NULL
6	11....	1073....	Makam Sultan Muhammad Syah Ibni Almarhum Raja Mansur Shah	Royal Tomb	Warisan	1072_ Makam S...	Pulau Tiga	NULL
7	12....	1074....	Makam Sultan Ahmad Tajuddin Shah Marhum Muda	Royal Tomb	Warisan	1074_Makam S...	Pulau Tiga	1074_Makam S...
8	13....	1075....	Makam Megat Terawis	Royal Tomb	Warisan	1075_Makam M...	Kampong Gajah	1075_Makam M...
9	14....	1076....	Makam Sultan Abdullah Muazzam Shah	Royal Tomb	Warisan	NULL	Pasir Panjang H...	NULL
10	15....	1077....	Makam Sultan Abdul Malik Shah	Royal Tomb	Warisan	NULL	Bandar	NULL

Figure 3: Attribute Tables of Royal Mausoleums

GIS could be linked to the real-world environment by using 3D Earth without digitizing for 3D Modelling that potentially speed up the process. The layer of mausoleums then export in (*kml) to be linked into Google Earth Pro. By dragging it in the mouse's direction, the user could move the 3D earth in any direction. In addition to map enlargement and reduction for display purposes, it is also possible to fly a systematic map to a panorama position and display the map of locations using the panoramic feature. The directions also include how to slide and rotate the map. The compass feature can be used to display the direction; labels in the form of text, images, or videos can be displayed on the ground or above it. Refer to Figure 9 QGIS software linking with Google Earth with Pictures.

Future Suggestion

Through WebVRGIS, VR and GIS improve the fundamental infrastructure, including various key technologies that facilitate data posting on the network, data transmission, and a high number of online users (Li et al., 2016).Virtual worlds can represent cultural landmarks in their natural environment or within a museum. For instance, displayed in a location where it was originally, in narrative with sound and effects. Users can visit places the way they were at a different time in history through the digital reconstruction of a historical and story of Perak Sultanate.



MAP OF MAUSOLEUMS IN PERAK TENGAH DISTRICTS

1. Makam Sultan Muzaffar Shah I
2. Makam Sultan Ahmad Tajuddin Shah Marhum Muda
3. Makam Sultan Alauddin Shah & Sultan Ahmaduddin Shah
4. Makam Sultan Mahmud Shah ibni Almarhum Sultan Muhammad Shah
5. Makam Sultan Muzaffar Shah II
6. Makam Sultan Muzaffar Shah III
7. Makam Sultan Muhammad Syah Ibni Almarhum Raja Mansur Shah
8. Makam Sultan Abdul Malik Shah
9. Makam Sultan Abdullah Muazzam Shah & Makam Sultan Jaafar Muazzam Shah
10. Makam Megat Terawis
11. Makam Ngah Sagor
12. Makam Puteri Limau Purut
13. Makam Almarhum Tepus Raja Sulong
14. Kubur J.W.W Birch
15. Makam Sipuntum

Figure 4: Mapping of mausoleums in Perak Tengah District in 2D

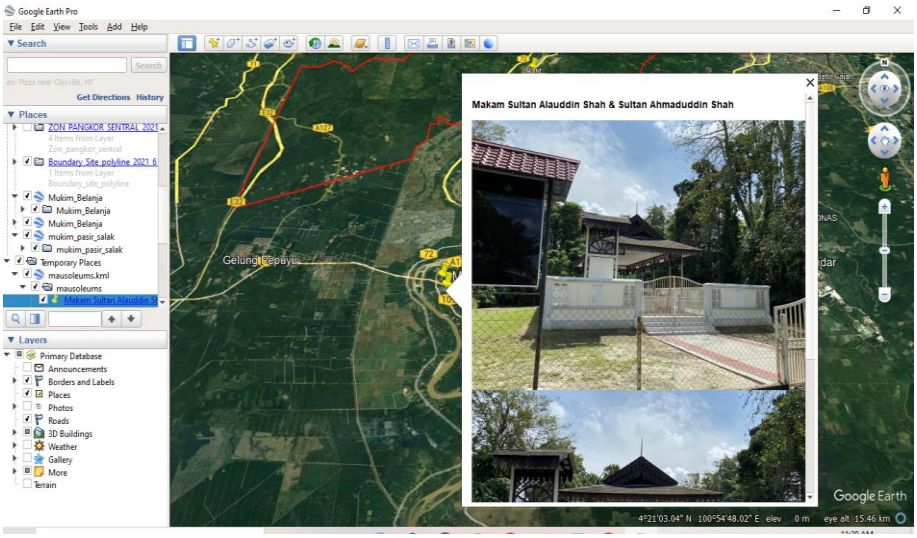


Figure 5: QGIS software linking with Google Earth with Pictures

CONCLUSION

There are 16 coordinate points of mausoleums and 1 museum had been discovered. In addition, the noteable figure in historic for Perak Tengah included. these mausoleums areas are supported by signage and wayfinding, accessibility of tourism, condition of tourism and support facilities that including parking that are in satisfactory for tourist to come yet need improvement especially road access, signages and wayfinding. The Royal mausoleums could be preserved with well-organized method for storing data that can map tomb plots and then be used as a reference reliant on GIS's benefits with and represent in realistic virtual environments where the public can immerse and interact with these artifacts which directly involves computer graphics and multimedia content, such as 3D objects, 2D images, sounds and music.The application of QGIS could be extended in websites to be access by public. This application as a base for tourism database to ease local operators or any tourism agencies. Additional features such as to add up 3D modelling or other tourist attractions can be plan for future collaboration with Perak Tengah District Councils.

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