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DEVELOPMENT OF A GEO-INFORMATICS DATABASE SYSTEM TO SUPPORT URBAN CONSERVATION AND REHABILITATION: A CASE STUDY OF MUEANG RATCHABURI DISTRICT, THAILAND

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ABSTRACT

This research aims to investigate and process information of important buildings with historical and cultural values in the old town of Mueang Ratchaburi district in Ratchaburi province, Thailand and to develop a database system to support urban conservation and rehabilitation. This research was qualitative using a field survey and in-depth interviews with 15 government and private agencies who were involved in the conservation of important buildings in the area. Data was then collected and analyzed to develop a geo-informatics database system to support the urban conservation and rehabilitation of these important buildings. The results showed that there were a total of 43 historic sites and important buildings in the district, of which 19 were already registered with the Fine Arts Department. Many of these important buildings, 16 sites in total, were located in the Na Mueang subdistrict. A database was then developed in the geographic information system by creating a database on Google Sheets so that users could easily add, delete or edit information. A connection was then made to the AppSheet platform to enable viewing on both smartphones and web browsers. It was found that users could update, manage, and view data on the map. Users could also search information, calculate the route and duration, and connect to the links to see the registration documents that appear in the Royal Thai Government Gazette for buildings registered with the Fine Arts Department.

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1. INTRODUCTION

Cities in Thailand have been affected by developments and changes caused by social and economic conditions. Consequently, the original identities of old towns and the townscapes have changed. This has led to conflicts and degeneration in the former city areas. Old town areas are potential targets for urban

regeneration because they are the starting point of history, art and culture, and way of life of the people there. These areas also serves as a testimony to the settlement of communities, and is usually an important economic area of a city in terms of administration, social activities, trade, services, tourism and employment. However, long-established old town areas often have physical problems that do not support densification of land use and intensive urban development activities like narrow alleys, winding roads, congestion of people, intense economic activities, and high density buildings. As a result, the condition of old towns generally deteriorates and lacks effective use. It is necessary to take measures to revitalize old town areas in cities, but the regeneration of the areas must be developed systematically and be suitable for the development of physical, economic, social, cultural, and technological aspects in the future. The rehabilitation must be able to preserve the value of the area and further develop it in line with the master plan for the conservation and development of the old city of the Office of Natural Resources and Environmental Policy and Planning, which requires comprehensive information on the general physical and geographical data, climate, archaeological history information, information on art, architecture, culture, tradition, and local wisdom. Projecting information in the area that affects the old town landscape architecture and environment, utilities, economy, tourism information and even the form of natural disasters in each area is also required. (Office of Natural Resource and Environmental Policy and Planning, 2021) In addition, the survey and development of the important building database are of great importance in order to preserve the old buildings with the historical and cultural value of old towns in line with strategy 2 "The creation of a central geospatial data system of the government sector" and strategy 3 "The development of a portal and a service system for providing geospatial information in all sectors" of the National Geo-informatics System 2017–2021 master plan in the preparation for a spatial database that can be used by all agencies. (The National Geo-Informatics Board, 2017)

Mueang Ratchaburi district was chosen for this research study. Ratchaburi's center is an old city on the Mae Klong River with a long history, and many old buildings and landmarks. According to information from the Cultural and Natural Environment Management Bureau (2017), Ratchaburi was an ancient city that probably flourished in the late 15th Buddhist century. It was influenced by the spread of ancient Khmer culture into the Chao Phraya River Basin with empirical evidence including Wat Mahathat Worawihan. Traces of a stone castle built in the Dvaravati period was also found. There are also many other important historical and cultural buildings and monuments. Thus, the old city of Ratchaburi has a long history and development in the fields of history, society, culture, and settlement. There are many important historical sites in the old town of Ratchaburi. Most are located in the territory of Ratchaburi municipality. The ancient monuments, buildings, and sites are unique to the local architecture, such as the Ratchaburi city walls and moats in the Na Mueang subdistrict in the west, next to the Mae Klong River and on the same side as the ancient city of Khu Bua and Snake Mountain, which is about 5 kilometers from the ancient city of Khu Bua to the northwest. Evidence of ditches and embankments like the ancient city walls and ditches were found to have a rectangular shape with a width of 750 meters and a length of 2,250 meters. In addition, there were 6 forts and 6 gates, but only 2 of them have remain at present: the fort at the corner of the southwestern wall and the fort in the middle of the wall on the southern side. As for the current city gates, the condition of the 4 arches of all 6 gates can still be seen, but all of them are damaged.

The researcher wanted to collect information on important buildings with historical and cultural values of the ancient city so that they are not lost. Geoinformatics was used to manage spatial databases to support the development of database systems that are important for the future urban conservation and rehabilitation in the ancient city of Mueang Ratchaburi, and to support the establishment of ecotourism routes in Ratchaburi province and its surrounding area.

2. LITERATURE REVIEW

In this research, the concept of urban renewal was applied to both the basic principles of the urban renewal of the United Nations Office for Human Settlements (UN -Habitat) (Chula Unisearch, Chulalongkorn University, 2015), which explains the principles of urban development, and urban rehabilitation—the classification of urban rehabilitation projects: urban development, urban rehabilitation and urban conservation. This research also considered Catanese and Snyder's concept of urban and historical preservation (1979, cited in Phiromruen, 2004) which explains the concept of preserving cities and historic districts, motivation for conservation, categories of conservation and criteria for conservation. The concept of database system development (Sriphaisarn, 2010) on the important factors in system development requires the acquisition of accurate, complete and fast data by using the information system as a tool to immediately transform data into forms information. The information must be accurate and up to date with minimal duplication of data and sharing of information, along with relevant academic articles and related documents. It was found that there was a lot of interesting research on the conservation of old towns in Thailand in the past,

including the conservation of vernacular buildings in the old town district of Sakhon Nakhon by Pattananurot (2014), guidelines for the development of sustainable tourism in Vienglor, Chun district, Phayao province by Boonyai (2015), and research by Suphan (2016) who investigated the participation of local people in the conservation of the old town of Nakhon Si Thammarat. Most of the research was based on the concept of preservation of the old town according to the guidelines of UNESCO and field studies to explore the spatial-physical characteristics, the communities, and the surroundings. In addition, there were questionnaires and interviews with people who were involved in the preservation of the old city communities such as the government, the private sector, and the people in the area. There were also efforts to develop a database of ancient sites, religious sites, and ancient buildings of historical or cultural values. This research is in line with the research of Montri et al. (2017) who studied the development of a database of local wisdom, cultures, and traditions in Nanglea subdistrict, Mueang Chiang Rai district in Chiang Rai province on mobile devices. Such device was convenient, fast, and easy to use, and could be used to develop cultural tourism in the region. The research of Rattapong et al. (2020) examined approaches for sustainable development of creative tourism in Ratchaburi province, Thailand by conducting a SWOT analysis and established guidelines for the development of sustainable creative tourism in the province.

This research was interested in studying the development of a building database system that has historical and cultural values in the old city of Ratchaburi. In this research, Mueang Ratchaburi district was the focus for the preservation of ancient sites, city walls and arches, and original ancient buildings that are of historical and cultural value to the old city. It managed the geographic information system as a spatial database to support the development in the future, especially the database to support the establishment of an ecotourism route in Ratchaburi province and the neighboring areas. This research was conducted to be in line with the project "The Conservation and Development of Ratchaburi Old Town towards Creative and Livable City for Cultural-based Economic Advancement and Sustainable Living", a Silpakorn University Research, Innovation and Creativity Administration Office (2021) project, which gathered knowledge from various fields of research that would help lead to the development of continuity and sustainability in Ratchaburi.

3. RESEARCH METHODOLOGY

The main focus of this research was to collect information on ancient sites and buildings of historical and cultural importance for a database by studying the policies, measures, and management of land use in urban areas in Mueang Ratchaburi, through the study of related documents and scientific works of relevant authorities. The physical characteristics and location of the old town community in Mueang Ratchaburi district were studied by reviewing documents related to the study area in terms of their history and cultures. Next, the old town was explored through field surveys of the historically and culturally significant buildings according to Catanese and Snyder's selection criteria for conservation (Phiromruen, 2004) along with in-depth interviews with both government and private agencies who were related to the old city community in the Mueang area. Sample documents for data collection were drawn from the 1st Regional Office of Fine Arts Department Ratchaburi, the 1st Office of Archeology and National Museum of Ratchaburi, Ratchaburi Provincial Office of Tourism and Sports, the Department of Public Works and Town & Country Planning of Ratchaburi, the Office of Ratchaburi Culture, and related private sectors. Informants who agreed to participate in the research to provide information were from the government and the private sectors with at least 5 years' professional experience in the preservation of old buildings and communities. There were 15 informants in total: 5 from the government agencies and 10 from related private and local sectors. The research employed notetaking and audio recording to collect information for the interview about the problems and needs of web application users to design a web application for use. Finally, the data obtained was used to design and create a geographic information system database. A web browser database system was developed to collect and disseminate databases to support urban conservation and rehabilitation in the old town. Google Sheets was used to create an online database to combine with the AppSheet platform. The display and instruction for data tables created on Google Sheets was then connected to the AppSheet platform to customize the application to display data in three main areas: data storage and information update, information and pictures of the place, and the location on the map. The application could be installed and run on a smartphone or web browser. Users of the application could edit or manage data, view maps, and report preliminary results in a dashboard format and let the relevant people try and adjust the function according to the needs of the users. After testing, suggestions were collected to improve the database system and applications accordingly. The researcher followed the conceptual research framework as the research method, which can be summarized in Figure 1.

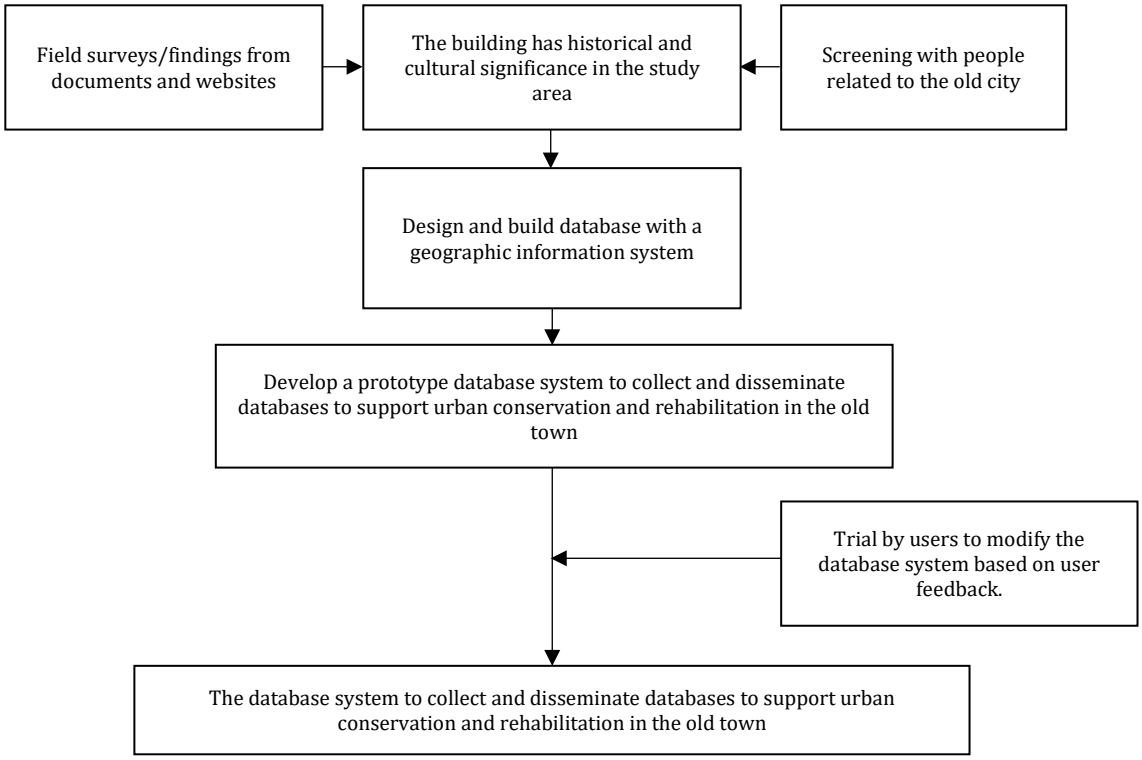

Figure 1: Conceptual framework

4. RESULTS

With the review of registration documents of archaeological sites and historical sites compiled by the 1st Regional Office of Fine Arts Department Ratchaburi (Strategy and Information for Provincial Development Unit, n.d.) and a survey of important buildings with the historical and cultural values of the ancient city in Mueang Ratchaburi district, it was found that it had a total of 19 registered archaeological sites. There were 8 sites located in Na Mueang subdistrict: Mahathat Worawihan Temple, Ratchaburi National Museum (Former Ratchaburi City Hall), Ratchaburi District Court Building, Khao Luea Temple, Phleng Temple (dilapidated), Thep Awat Temple, Sua Pa Club Building (Public Health Center), and Sri Suriyawongsaram Temple. Others were scattered in different subdistricts: 4 sites in Khu Bua subdistrict (Klong Temple (Archaeological site no. 18); Archaeological Site No. 1 Mueang Khu Bua; Archaeological Site No. 1 Mueang Khu Bua; and Archaeological sites number 24 and 25 Mueang Khu Bua), 3 sites in Koh Phlapphla subdistrict (Ruesi Khao Ngu cave; Fa Tho cave, Buddha's footprints, Chin cave, Cham cave; and Rakhang cave), 2 sites in Khung Nam Won subdistrict (Khung Krathin Temple and Tha Suwan Temple) and 2 sites in Chedi Hak subdistrict (Chedi Hak—ancient broken stupa and Aranyikawat Temple) as indicated in Table 1.

As for the unregistered archaeological sites, a field survey and in-depth interviews with informants from government agencies and private sectors reported a total of 53 sites, 24 of which were found in Mueang Ratchaburi district. Many of them (8 sites) were located in Na Mueang subdistrict: Koh Namthap Thawancharam Temple; Ratchaburi Provincial Government Court; Ratchaburi wall and moat; Rong Chang Temple; Old Ratchaburi governor's house; Sattanat Pariwat Worawihan Temple; Chong Lom Temple; and Ratchaburi's Clock Tower. There were 3 sites in Khok Mo subdistrict: Amarintraram Temple (Tan Temple); Siri Charoen Noen Mo Temple (Kok Mo Temple); and Phaya Mai Temple. There were 2 sites located in the following subdistricts: Chedi Hak (Jetiyaram Temple and Khao Wang), Don Rae (Thungya Khum Bang Temple and Na Nong Temple), Tha Rap subdistrict (Ban Chong Temple and Khlong Pho Charoen Temple), and Ang Thong (Khao Luang and Yai Ang Thong Temple). Finally, 1 site was located in the following subdistricts: Koh Phlapphla (Don Talung Temple), Khao Raeng (Khao Wang Saduang), Khu Bua (Mueang Khu Bua), Phong Sawai: (Ratchaburi's City Wall (Phanurangsi's Ratchburi Engineering Military Camp)), and Lum Din (Surachayaram Temple (Lum Din Temple)).

Table 1: Archaeological sites and old buildings with registration and non-registration documents in Ratchaburi district, Ratchaburi province

Subdistrict	Archaeological Site	Latitude	Longitude	Registration Announced	Landmark from the Survey
Na Mueang	- Mahathat Worawihan Temple	13.547419	99.814426	1st 8/03/1935 2nd 31/05/1983	- stupa, mandapa, temple base
	- Ratchaburi National Museum (Former Ratchaburi City Hall)	13.541181	99.817690	1st 10/05/1977 2nd 22/09/2005	- former Ratchaburi City Hall
	- Ratchaburi District Court Building	13.539997	99.819497	1st 10/05/1977 2nd 14/02/1989	- Ratchaburi District Court Building
	- Khao Luea Temple	13.543653	99.812331	18/2/1996	- 12-cornered wooden pagoda
	- Phleng Temple (dilapidated)	13.551582	99.815219	6/10/1995	- pagoda during the Ayutthaya period
	- Thep Awat Temple	13.538124	99.839486	10/09/2001	- old chapel, bell tower
	- Sua Pa Club Building (Public Health Center)	13.533761	99.809270	6/10/2000	- former boy scout club building
	- Sri Suriyawongsaram Temple	13.540408	99.815897		- chapel, cloister, pagoda
	- Koh Namthap Thawancharam Temple	13.540524	99.830017		- pottery, Buddha statue
	- Ratchaburi Provincial Government Court	13.541178	99.818279	10/09/2001	- former Government Court
	- Ratchaburi's Wall and moat	13.545123	99.825689		- old city wall, moat
	- Rong Chang Temple	13.542199	99.813203		- pagoda
	- Old Ratchaburi governor's house	13.540399	99.825548		- old governor's house
	- Sattanat Pariwat Worawihan Temple	13.538893	99.827165		- chapel, temple, pagoda
	- Chong Lom Temple	13.542787	99.816539		- Chinese arch
	- Ratchaburi's Clock Tower	13.540376	99.820437		- clock tower
Khok Mo	- Amarintraram Temple (Tan Temple)	13.547640	99.821130		- chapel, pagoda, Buddha statue
	- Siri Charoen Noen Mo Temple (Kok Mo Temple)	13.561726	99.821547		- stupa, pagoda, boundary marker of the temple (baisema)
	- Phaya Mai Temple	13.553831	99.820069		- wall and arches, chapel
Khu Bua	- Klong Temple (Archaeological Site No. 18)	13.486403	99.835695	30/10/1970	- archaeological site No.
	- Archaeological Site No. 1 Mueang Khu Bua	13.494033	99.827242	10/09/2001	- archaeological site No. 1
	- Archaeological site No. 8 Mueang Khu Bua	13.490663	99.831185	10/09/2001	- archaeological site No. 8
	- Archaeological sites number 24 and 25 Mueang Khu Bua	13.482798	99.837150	7/11/2005	- archaeological sites No. 24 & 25
	- Mueang Khu Bua	13.490791	99.838224		- archaeological site
Koh Phlapphla	- Ruesi Khao Ngu cave	13.574952	99.777283	1st 8/03/1935 2nd 15/10/1974	- Buddha image carved
	- Fa Tho cave, Buddha's footprints, Chin cave, Cham cave	13.574822	99.774671	15/10/1974	- Buddha image carved - monogram of King
	- Rakhang cave	13.583422	99.756665	15/12/1970	Rama V on the cave wall
	- Don Talung Temple	13.575959	99.783669		- chapel, pagoda
Khung Nam Won	- Khung Krathin Temple	13.529237	99.882228	18/12/1996	- chapel
	- Tha Suwan Temple	13.529133	99.894608	18/12/1996	- chapel, pagoda
Chedi Hak	- Chedi Hak (ancient broken stupa)	13.542921	99.798346	20/12/1998	- old pagoda
	- Aranyikawat Temple	13.566993	99.798624	20/12/1998	- stupa, chapel, pagoda
	- Jetiyaram Temple	13.544596	99.798419		- octagonal pagoda
	- Khao Wang	13.529899	99.795055		- former Royal guard barrack, former throne room
Don Rae	- Thungya Khum Bang Temple	13.471493	99.761387		- pagoda, sermon hall
	- Na Nong Temple	13.492126	99.764506		- chapel, bell tower, sermon hall
Tha Rap	- Ban Chong Temple	13.621243	99.808061		- pagoda, Buddha statue
	- Khlong Pho Charoen Temple	13.605297	99.798793		- Buddha statue
Ang Thong	- Khao Luang	13.486537	99.784396		- pagoda, former temple base
	- Yai Ang Thong Temple	13.485299	99.792927		- chapel, mural

Table 1: Archaeological sites and old buildings with registration and non-registration documents in Ratchaburi district, Ratchaburi province (Continued)

Subdistrict	Archaeological Site	Latitude	Longitude	Registration Announced	Landmark from the Survey
Khao Raeng	- Khao Wang Saduang	13.613701	99.771525		- monogram of King Rama V on the rock
Phong Sawai	- Ratchaburi's City Wall (Phanurangsi's Ratchburi Engineering Military Camp)	13.544612	99.823910		- old city wall
Lum Din	- Surachayaram Temple (Lum Din Temple)	13.562511	99.817259		- chapel, pagoda, stupa, bell tower

Source: Strategy and Information for Provincial Development Unit. (n.d.)

Based on the combined survey data, most sites were found in Na Mueang subdistrict (16 sites), followed by Khu Bua subdistrict (5 sites), Koh Phlapphla subdistrict (4 sites), and Chedi Hak subdistrict (4 sites) as shown in Figure 2 and Table 2.

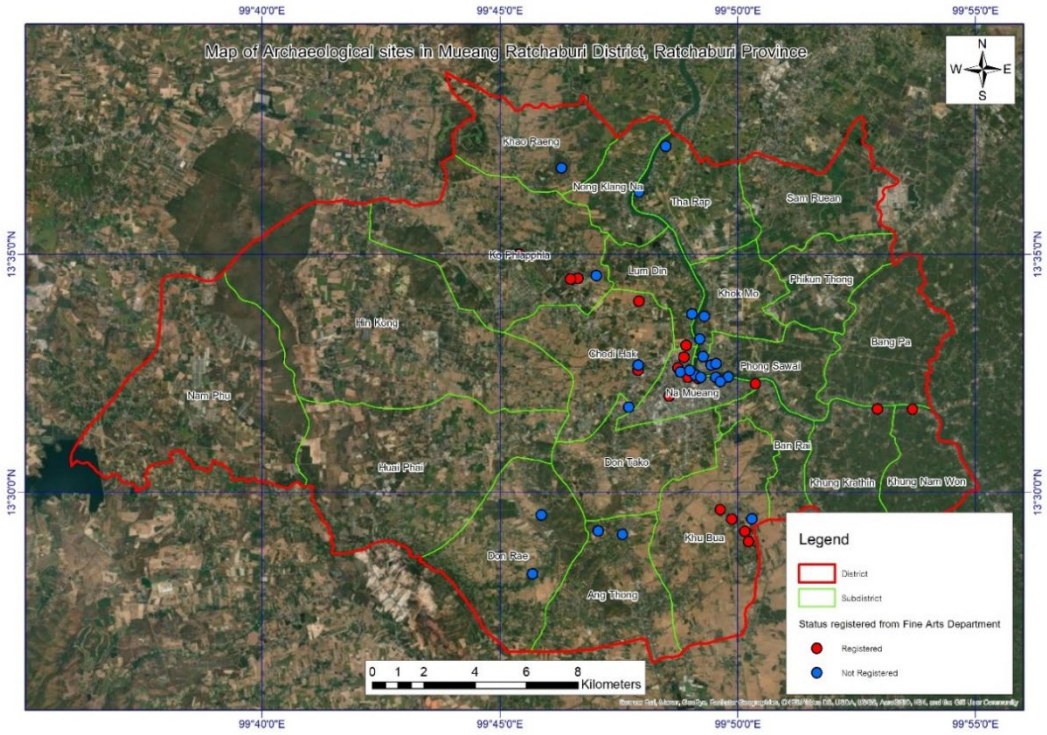

Figure 2: Map of archaeological sites in Mueang Ratchaburi district

Table 2: Registration status of Archaeological sites in Mueang Ratchaburi district, classified by subdistrict

Subdistrict	Archaeological Sites		
	Registered	Not registered	Total
Na Mueang	8	8	16
Khu Bua	4	1	5
Koh Phlapphla	3	1	4
Chedi Hak	2	2	4
Khok Mo	-	3	3
Khung Nam Won	2	-	2
Don Rae	-	2	2
Tha Rap	-	2	2
Ang Thong	-	2	2
Khao Raeng	-	1	1
Phong Sawai	-	1	1
Lum Din	-	1	1
Total	**19**	**24**	**43**

The data obtained from field surveys and interviews was used to create a spatial database consisting of the place names, locations, geographic coordinates, area sizes, images, registration status, and links to the registration with the Fine Arts Department displayed in the Government Gazette. Finally, the created database was converted to an internal database on AppSheet to link the geospatial data and to display it on a smartphone or web browser with a map, as shown in Figure 3.

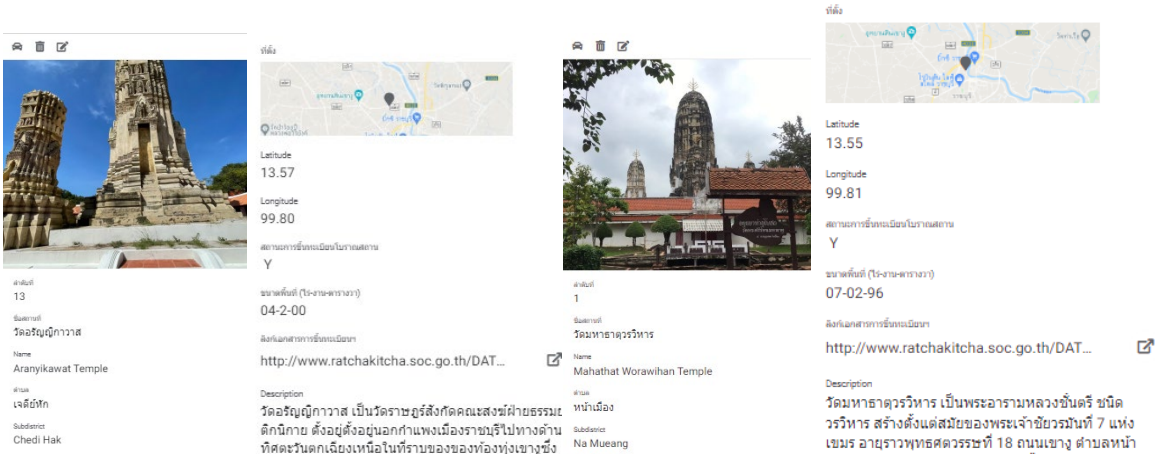

Figure 3: Geographic information system database on Google Sheets

When the application development was completed, it was tested by users. It was found that there were still problems with the display of function information bars and display areas, slow processing when uploading images, and the inability to operate without an internet connection. Therefore, some parts have been modified to be usable according to the needs of users.

The display and the data tables created on Google Sheets were connected to AppSheet to customize the application to display the data in two main parts: (1) the map of the archaeological sites and important buildings in Mueang Ratchaburi district, and (2) information about their features. The application could be run after being installed on a smartphone or a web browser. Users of the application could update, manage, and view the information on the map. They could also search for information, see the route, calculate the duration of their trip, and connect to the links to information on the registration documents that appeared in the Royal Thai Government Gazette for buildings registered with the Fine Arts Department as shown in Figures 4–6.

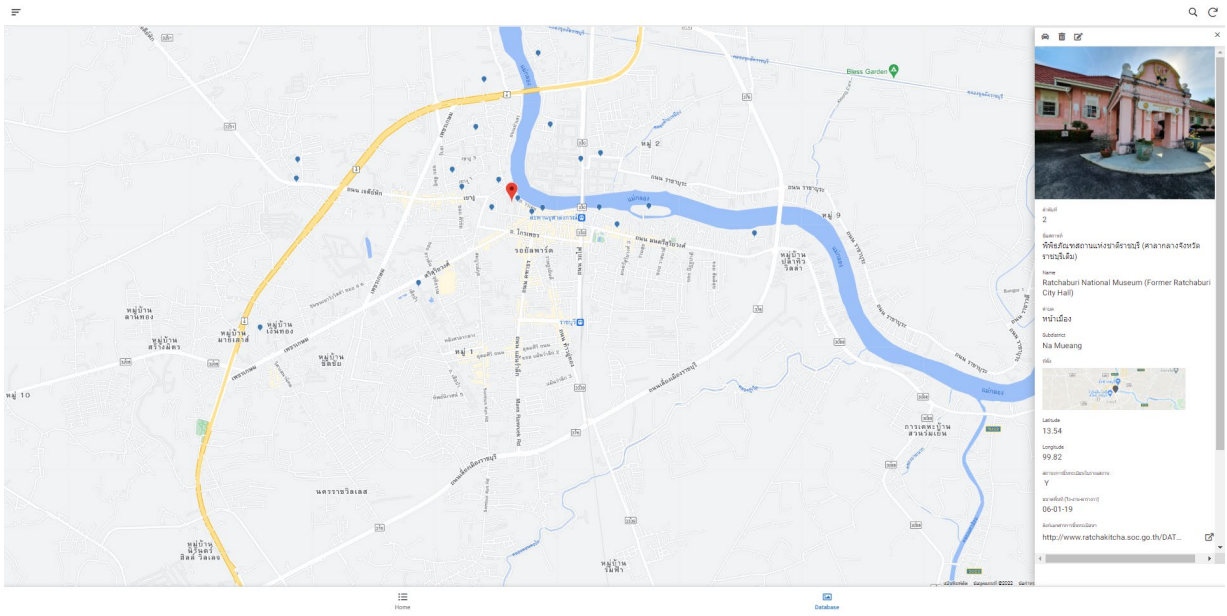

Figure 4: Display of the application on a web browser

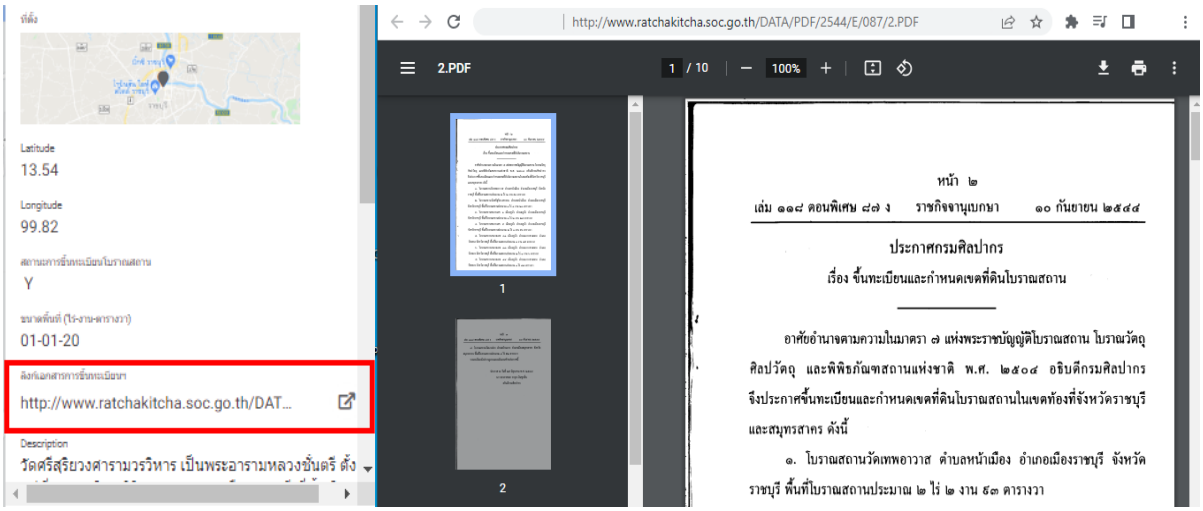

Figure 5: Linking to registration documents in the Government Gazette

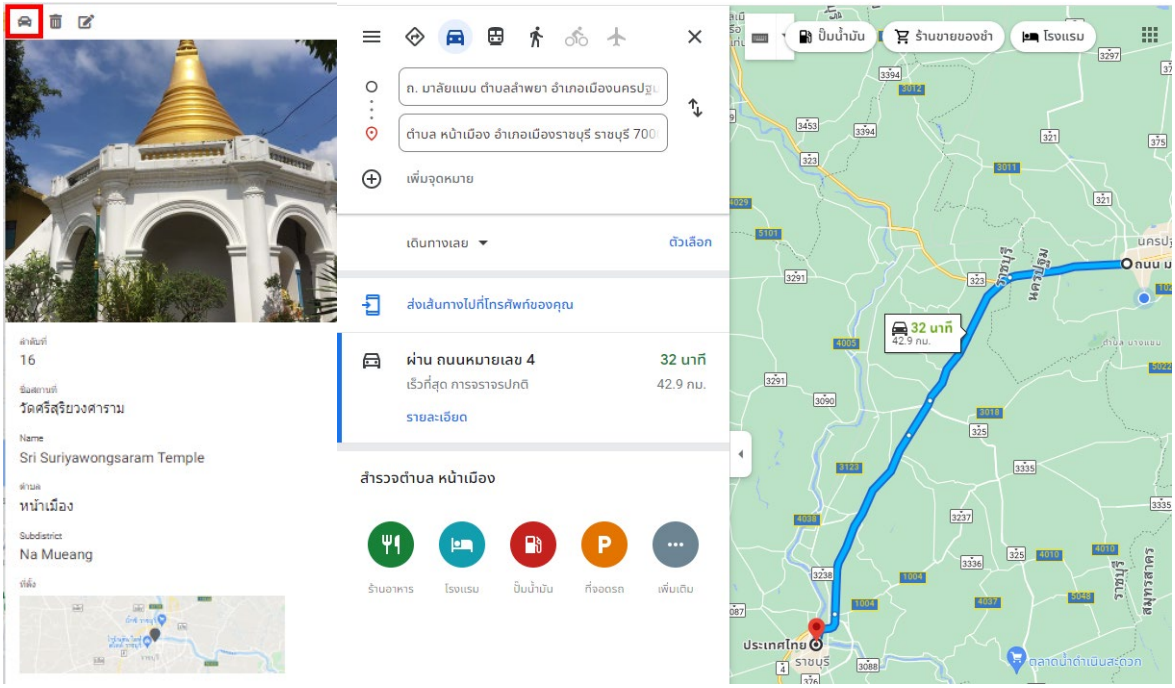

Figure 6: Calculation of route, distance, and time required to travel to a desired destination

5. DISCUSSIONS AND CONCLUSION

The results of the study revealed that there were 43 archaeological sites and important buildings in Mueang Ratchaburi district. The Fine Arts Department had 19 of them as registered archaeological sites. The other 24 sites have yet to be registered because when the relevant agencies surveyed and colleced data, it was found that they did not accord to the Catanese and Snyder's (1979, cited in Phiromruen, 2004) conservation concept criteria for important buildings to be preserved. Most archaeological sites and important buildings (16 sites) were located in Na Muang subdistrict. With the information about the location of archaeological sites and important buildings, a spatial database was created as a geographic information system. Google Sheets was the chosen platform because users could easily add, delete, or edit data, and connect it to the AppSheet. The database could be viewed on both smartphones and web browsers. The results of the research also showed that users of the application could update, manage and display information on the map. They could also search for information, the route to and the duration of their potential trips, and could connect to the links to the

registration documents that appeared in the Government Gazette for buildings registered with the Fine Arts Department.

This research was congruent with the research of Montri et al. (2017) who studied the development of a mobile database on the wisdom, cultures, and local traditions in Nang Lae community, Muang Chiang Rai district in Chiang Rai province. Wijitra found that such database was convenient, fast, and easy to use, and could be used to develop cultural tourism in the region. Developing such a database system could be a way to encourage people's participation in monitoring, preserving, maintaining, and improving ancient monuments and significant buildings, leading to sustainable tourism development. This was also in line with the research of Pattananurot (2014), who conducted a study on the conservation of local buildings in the ancient area of Sakon Nakhon, and the research of Boonyai (2015), who conducted a study on the development of the ancient town of Wiang Lo in Chun district, Phayao province for sustainable tourism that has applied the concept of urban and historical preservation for preserving and developing the city by integrating the government, the private sector, and the people in the region and formulating policies, strategies, and guidelines for the long-term conservation of ancient monuments and important buildings.

6. RECOMMENDATIONS

This research can serve as a model for the development of a spatial database system to record and track archaeological sites and significant buildings in support of urban conservation and restoration. It also encourages further development of natural and cultural tourism in other areas, but we need to add valuable old building surveys from interviews with communities in the areas to get more complete information. Developmental potential of further sites can be researched in order to prioritize the preservation and improvement of the sites. This application development work focuses on the perspective of users from related agencies. Therefore, there should be more interviews from the point of view of tourists and data can be collected from visitors of important archaeological sites and buildings to elicit their opinions on the improvement of the sites. There are also suggestions from users, such as increasing processing speed, reducing the time it takes to upload data, being able to operate without an internet signal, and adjusting some functions to be compatible with other programs. This will lead to their development and improvement in terms of cultural values and sustainability, to support future tourist activities. It can be developed into a spatial database system that supports information search and travel planning to support decision making in planning tourist routes.

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