Development of Internet GIS Application of Traditional Tourism Village Koto Baru, South Solok, West Sumatra, Indonesia

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Abstract. The halal tourism industry is rapidly developing and has become a current trend. It is a subcategory of tourism geared towards offering services that comply with Islamic principles for tourists. Indonesia has excellent potential for the development of this tourism industry because it is majorly populated with Muslims. For the first time, the country and Malaysia were ranked the world’s best halal tourist destinations in 2019. One of the oldest halal destinations in Indonesia is the Thousand Big Houses Area, in Koto Baru village, West Sumatra. However, due to limited information and technology, this area is less visited by tourists despite being hundreds of years old with the Minangkabau traditional building, which acts as a tourist attraction. Therefore, one of the solutions to help introduce this house to the world is developing an Internet Geographic Information System (GIS) for the village. This research aims to develop this application using the waterfall software development method. The application was programmed using PHP and Javascript, while its user interface was developed using the CSS Bootstrap framework. The results showed that the output was in accordance with the expectations that the app can be used to promote the village.

1. Introduction

Halal tourism makes tourists feel more comfortable and safe during their trips [1]. This type of tourism is incessantly carried out in Malaysia, Japan, Australia, and France as a subcategory of tours offered [2]. In addition, these countries have realized that Muslims are ranked the second religion with the most significant population growth after Christians [3], with an estimated increase of 70% between 2015 and 2060 [4], as shown in figure 1.

As a Muslim-majority country, Indonesia has the potential to lead in this industry, which is meant for all tourists [5]. The essence of its existence is to emphasize the principles of Sharia in the management and service of tourism that is polite and friendly to all tourists and the environment [6]. Some factors that influence halal tourism’s success are the availability of accommodation, food and drinks, prayer facilities, human resources, and continuous innovation [5,7]. According to the Global Muslim Travel Index (GMTI), Indonesia was ranked 3rd in 2017 and 2nd in 2018 for world halal tourism [6]. Furthermore, in 2019, the country was ranked first in the world, along with Malaysia [8]. The country also experienced an increase in the number of tourists in the tourism industry from previous years. The world's top 10 halal tourist destinations in 2019 are shown in Table 1.
Figure 1. 2015-2060 Population growth projection based on religion [4].

Table 1. Top 10 halal travel destinations in the world [8].

| RANK | DESTINATION             | SCORE |
|------|-------------------------|-------|
| 1    | Malaysia                | 78    |
| 1    | Indonesia               | 78    |
| 3    | Turkey                  | 75    |
| 4    | Saudi Arabia            | 72    |
| 5    | United Arab Emirates    | 71    |
| 6    | Qatar                   | 68    |
| 7    | Morocco                 | 67    |
| 8    | Bahrain                 | 66    |
| 9    | Oman                    | 66    |
| 10   | Brunei                  | 65    |

West Sumatra is a province in Indonesia designated as a halal tourist destination [9]. It is majorly populated by Muslims and the people of the Minangkabau area, with many buffalo horned traditional buildings called Big Houses [10]. These houses are used as residences that reflect the matrilineal system used to trace certain characteristics through the adaptation of maternal lineage, a symbol of togetherness, mutual cooperation, democracy, and identity of community chief attached to them [11]. One of the regencies in West Sumatra with numerous such houses and actively developing tourism in South Solok [10], while the Thousand Big Houses Area is located in the Koto Baru traditional village, is a dependable tourist destination area in the regency [12,13]. It has high national cultural values and hundreds of years old buildings that attract domestic and foreign tourists. In 2017, the Ministry of Tourism established the area as the most famous indigenous village in Indonesia [14], with approximately 138 big houses that attract tourists from all over the world [15].

Meanwhile, tourists need information on big houses in the area, with a system capable of disseminating information on the houses such as the owner’s name, ethnicity, type, and status in the form of residence or open only for customary events. Unfortunately, this village does not have a system used to achieve these tasks. Therefore one form of technology used to manage information on the Thousand Big Houses Area is Internet GIS, which is a system for integrating, disseminating, and
communicating geographical information [16]. The GIS comprises of a map interface used to assist tourists in locating and displaying information on the big houses in the village.

Research related to the development of Internet GIS applications for building management was carried out by [17-19]. The app was also developed for land and building ownership based on the Minangkabau tradition [17]. Other studies also developed an Internet GIS for a building based on its use as a residence, an office, place of worship, health center, and small and micro-industry [18]. Furthermore, research was carried out by [19] to develop the application for religious buildings to support halal tourism in Bukittinggi. The app allows users to locate other places adjacent to the buildings, such as attractions, restaurants, and hotels, which is similar to the studies carried out by [20,21]. However, these studies have not yet developed the Internet GIS application to disseminate information on Minangkabau traditional buildings/Big Houses as tourist attractions at the village level. Therefore, this research was carried out in accordance with the problem in Koto Baru village and previous studies. It also reported developing the Internet GIS app for the village to promote the Thousand Big Houses Area to have domestic and foreign visitors.

2. Materials and Methods

2.1 Study Area
This study was carried out in Koto Baru village, Solok Selatan regency, with a distance of approximately 150 km or travel time of 3.5 hours by road from Padang city West Sumatra as shown in Figure 2. This village is easy to locate due to numerous old, sturdy, and well-groomed houses along the road. Furthermore, this village is located close to the main road that connects Padang city with Kerinci regency, Jambi. It is marked by a big sign that reads "Kawasan Seribu Rumah Gadang," which means “Thousand Big Houses Area” [15].

Figure 2. Map of Koto Baru Traditional Tourism Village, South Solok Regency

2.2 Steps for Conducting Research
The application development method used in this study is the waterfall, a sequential design process that enables the complete execution of the previous stage before the current. The waterfall stages start from the analysis, design, coding, and testing [22].

A literature study and needs analysis was carried out in the analysis stage by defining the functional system. The data needed for system development are the attribute and spatial data of big houses, mosques, restaurants, small industries, and souvenir shops in the Thousand Big Houses Area. Aerial photographs of the Koto Baru village downloaded from Google, are needed to make a basic map. For the spatial data, geometrical data is needed in the form of polygons.

The database, user interface, and processes were carried out in the design stage. Figure 3 shows the ERD (Entity Relationship Diagram) of this application, while the user interface design is shown in Figure 4. It also comprises an interface used to search for a big house around the user's current position. Table 2 shows the interaction process scenario between the application and the user to
perform the search. Furthermore, the Internet GIS application was programmed using PHP and JavaScript, while its database was implemented using PostgreSQL/PostGIS.

The app is tested using the black-box testing method, and this was carried out to observe the overall system performance and ensure each function runs as expected. The data used for this process was obtained from Koto Baru village.

Figure 3. Entity relationship diagram of the app
Table 2. The scenario of finding big houses around the user position

| Use Case                          | Big houses search around user position |
|-----------------------------------|---------------------------------------|
| Participating Actor               | User                                  |
| Flow of Event                     | 1. The user selects a button nearby    |
|                                   | 2. The system displays a seek bar input form |
|                                   | 3. The user selects the desired radius by sliding the bar to the left or to the right |
|                                   | 4. The system displays the position and information of the big houses |
| Entry Condition                   | The user has opened the app            |
| Exit Condition                    | Users get positions as well as information on all the big houses around the user's position |

3. Result

In summary, the Internet GIS application of the village was programmed using PHP and Javascript, while the user interface was developed using the CSS Bootstrap framework. PostgreSQL/PostGIS was the database used, which is free and open-source software. The base map used was Google Maps, with its API and PostGIS functions utilized to support spatial operations. After the app has been developed, testing was carried out to ensure proper functioning.

Furthermore, the testing was the search for a big house based on a certain distance from the user's current position, which is the entrance gate of that area. This feature is useful to tourists in locating big houses close to them upon arrival in Koto Baru village. The testing procedure is shown in Table 3. Figure 5 shows the results of the Query test in PostgreSQL/PostGIS. In contrast, Figure 6 is the application's testing results, which illustrates that the developed app is in accordance with user requirements.

Table 3. Procedure for testing big houses with a distance of 500 meters from the gate.

| Action                          | Click the manual position and place the pin location. Then click the Nearby Button and slide the radius 500 meters |
|---------------------------------|-------------------------------------------------------------------------------------------------------------|
| Expectations                    | Appearances of big houses around the user position                                                           |
| Result                          | Appearances of big houses around the user position                                                           |
| Error                           | None                                                                                                        |
| Testing                         | True                                                                                                        |
Figure 5. Test results on Postgresql for distance-based big houses search.

Figure 6. The results of the search for big houses around the user based on distance.

The application provided the appropriate results between the output and the expectation mentioned earlier in this paper. Figures 7 shows an application output that displays supporting objects, including a mosque in the Thousand Big Houses Area within 500 meters of the user's position. This feature is useful for Muslim tourists willing to visit the mosque to pray. In addition, other tourism supporting objects are restaurants, small industries, and souvenir shops.

Figure 7. Search results for objects supporting the mosque.
4. Conclusion
The Internet GIS application for Koto Baru village, South Solok, West Sumatra in Indonesia, was successfully developed according to user needs. This application provides information needed by tourists regarding the big houses and other tourism supporting objects. The waterfall method was used in the application development, and the GIS Internet application was programmed using PHP and Javascript, while the user interface was developed using the CSS Bootstrap framework. The test results showed that the output was in accordance with the expectation. This application has been used to promote tourism at Thousand Big Houses Area in Koto Baru village.

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