

INTEGRATION OF QR-CODE AND WEB-BASED APPLICATIONS FOR DEVELOPING DIGITAL TOURISM IN IBOIH VILLAGE, INDONESIA AS A LESSON LEARNED MEDIA ON THE VOLCANIC ISLAND

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Abstract: The Great Sumatran Fault activity on Sumatra Island has presented a series of volcanoes and geological landscapes that can be developed as geo-tourism potential, such as in Iboih. The Weh Island has many natural tourism potentials that can be used to improve the community's income directly and as lessons learned for the dangers of living in a volcanic environment. The conventional method of delivering information is through a guide to visitors. This is very limited to the guide's ability to explain the phenomenon of tourist sites and the relation to lessons learned. In this study, we use the integration of QR-Code and web-based technology to develop a digital tourism system that can provide unlimited information to visitors and can be managed efficiently by the public. The data analysis shows that a QR code information board integrated with a web-based programming system can be used to monitor the number of monthly visitors at each tourism site. In addition, the java-script integration on the QR code board can present information that can be changed through links, images or videos without reprinting the QR-code model. Furthermore, we also present important locations from Iboih Village in the form of Web-GIS, such as tourist locations, road access, public infrastructure and food locations that tourists can easily access. Based on the research, we conclude that integrating QR-code and web-based programming can be an effective tool in tourism development as a medium for lessons learned by the community.

Key words: Geo-tourism, QR-Code, Web-GIS, Web-Based, Digital Technology

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INTRODUCTION

Weh Island is one of the areas in Aceh Province that has beautiful natural panoramas and underwater biodiversity (Abdullah et al., 2022; Marwan et al., 2020; Yanis et al., 2022). Geographically, this island is located at the western tip of Sumatra, directly adjacent to the Malacca Strait and the Indian Ocean, thus presenting a natural panorama that can be developed to attract visitors (Akla et al., 2019; Kurnio et al., 2016). The natural landscape in Weh Island creates a potential for tourism to increase the economic earnings for the community. The Weh Island such as Jaboi Village is famous for tourism for its volcanoes, Paya Village for marine tourism, and Iboih Village with various tourist destinations; there also has several geological landscapes, such as Sarang Cave and Rubiah Island, and several beaches that have the potential to be developed for geo-tourism (Akla et al., 2019). On the other hand, in this village there are also several old buildings designated as heritage destinations. So that Iboih has become one of the most visited destinations for domestic and foreign tourists in Pulau Weh. In addition, the consequences of tectonic and volcanic activities produce unique landscape forms, such as the presence of fault structures, underwater hydrothermal activity from volcanic activity, natural topography, and underwater panoramas that could be developed into tourist destinations (Yanis et al., 2021; Yanis et al., 2020), Figure 1 shows several tourist destinations in Iboih Village.

Currently, the development of tourism based on the geological landscape, apart from improving the community's economy directly, is also a new medium for increasing awareness about the potentially dangerous environment and education about the risks of living in a volcanic environment. One way to achieve the objectives of the lessons learned that impact the community is to provide content on tourist sites that contain geological information and the process of the existence of the volcanic mountain (Erfurt-Cooper, 2011; Newsome, 2006). However, this technique requires experience and training for tour guides which takes time and requires a lot of financial support (Marwan et al., 2020). Therefore, we

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utilize digital technology based on QR-Code which can provide in various languages to tourists from different countries and is independent of the ability to deliver data from tour guides. In this study, each tourist location will be installed with a QR Code-based digital information board integrated with the Iboih tourist information center website. The QR-Code integration with the web-based system can provide unlimited information capacity on tourist sites because they are digital and can be deleted, edited and updated as needed. This combination produces better benefits than classical methods, such as information boards commonly used in tourist sites (Ekundayo et al., 2020).

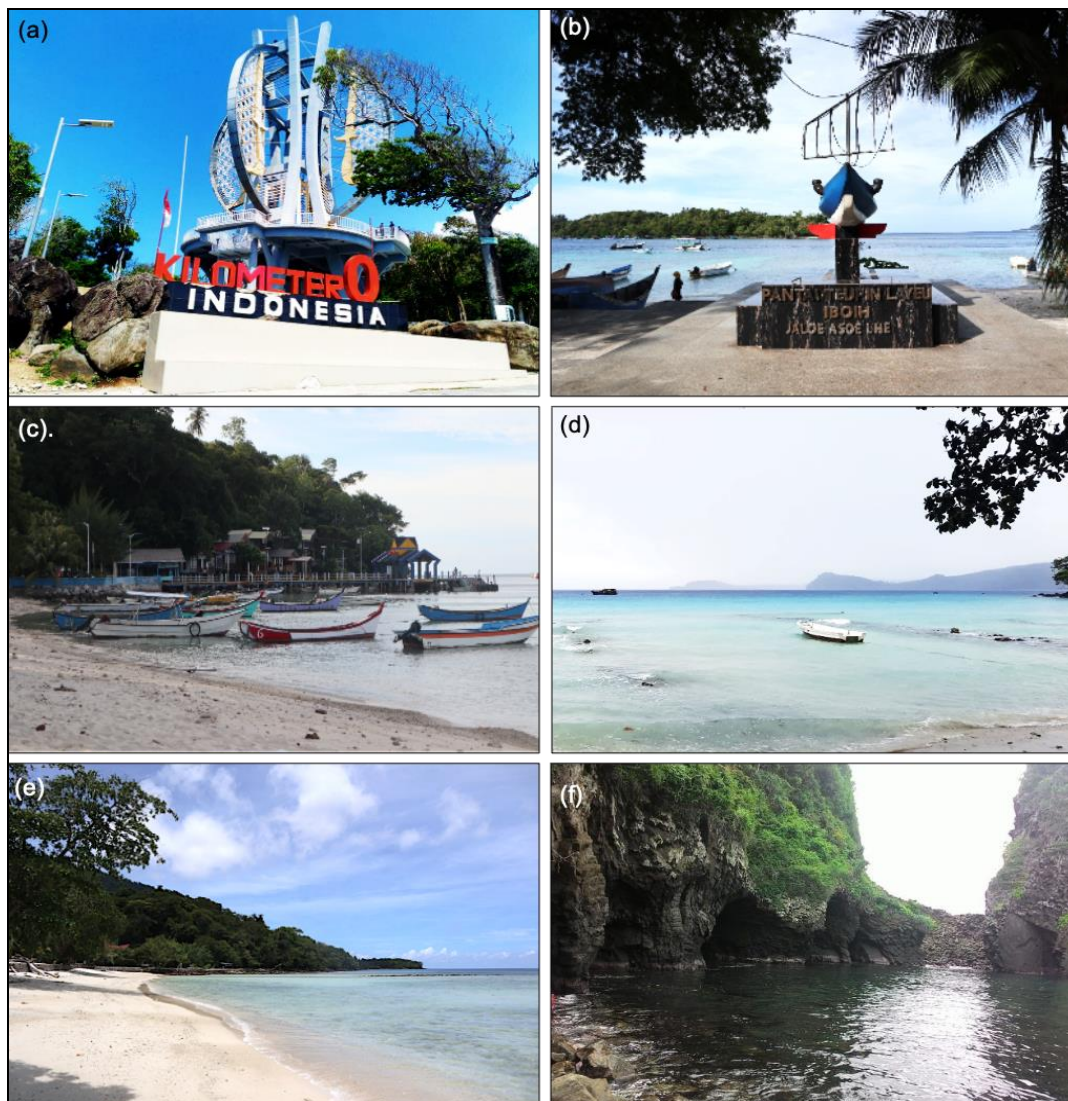


Figure 1. Some of the tourist destinations found in Iboih Village, Sabang are (a) Kilometer 0 which marks the starting point of Indonesian territory, several beaches such as (b) Iboih Beach, (c) Gapang Beach, and (e) Pasir Putih Beach, while (e) is Sarang caves formed by volcanic islands, this photo was taken on August 28, 2022

The use of the digital system for tourism purposes has been implemented in several developed countries such as in Southland Tourism Industry-New Zealand which combines information systems with QR-Code and NFC (Ekundayo et al., 2020), at heritage sites in Naples, Italy (Solima and Izzo, 2017), visitors management in Portugal based on QR-Code (Gutierriz et al., 2020), as well as a payment method at tourist destination locations in China (Tangit and Law, 2021). In addition, the development of the Iboih tourism digital system will also accommodate a camping permit system, feedback for message delivery with a web-based javascript language, as well as the implementation of a web-GIS system that provides various important Point of Interest (POI) information integrating with Google Maps, such as public sites, food, and tourism destinations. Specifically, this research aims to build a tourist destination in Iboih, Weh Island, as a digital tourism village with various features such as providing QR Code-based tourist information boards that can be updated as needed using the web, visualization of tourist destinations and other important information on the Web-GIS, as well as monitoring the number of visitors on QR-codes using web-based programming. The results can be applied to other locations, especially in developing countries, because this technology is easy, cheap and fast to transform into digital-based tourism.

Geological analysis of Weh Island

The tectonic activity of Sumatra Island has produced a series of volcanic island arcs that extend through the length of the island (Marwan et al., 2021). So along the active fault of the Great Sumatran Fault (GSF), which divides the island

of Sumatra from Lampung to the Andamans has presented various segments that can cause earthquakes (Burton and Hall, 2014; Marwan et al., 2021; Marwan et al., 2019a; Yanis et al., 2020).

On the other hand, this tectonic activity has provided several volcanoes such as Burnitelong (Yanis, et al., 2022), Seulawah Agam (Marwan et al., 2021; Marwan et al., 2019b, 2021), Peut Sagou (Yanis et al., 2020; Yanis et al., 2022; Zaini et al., 2022), and the Jaboi volcano (Yanis et al., 2022) which can be developed for electrical energy and also presents a natural landscape that can be developed for geo-tourism potential. This not only can directly improve the community's income, but it could also be used for educating people about the dangers of living on volcanic islands. Figure 2 shows a map of Iboih's tourism for potential disasters starting from the distribution of faults, manifestations, and volcanoes for lessons learned on the dangers of living in a volcanic environment.

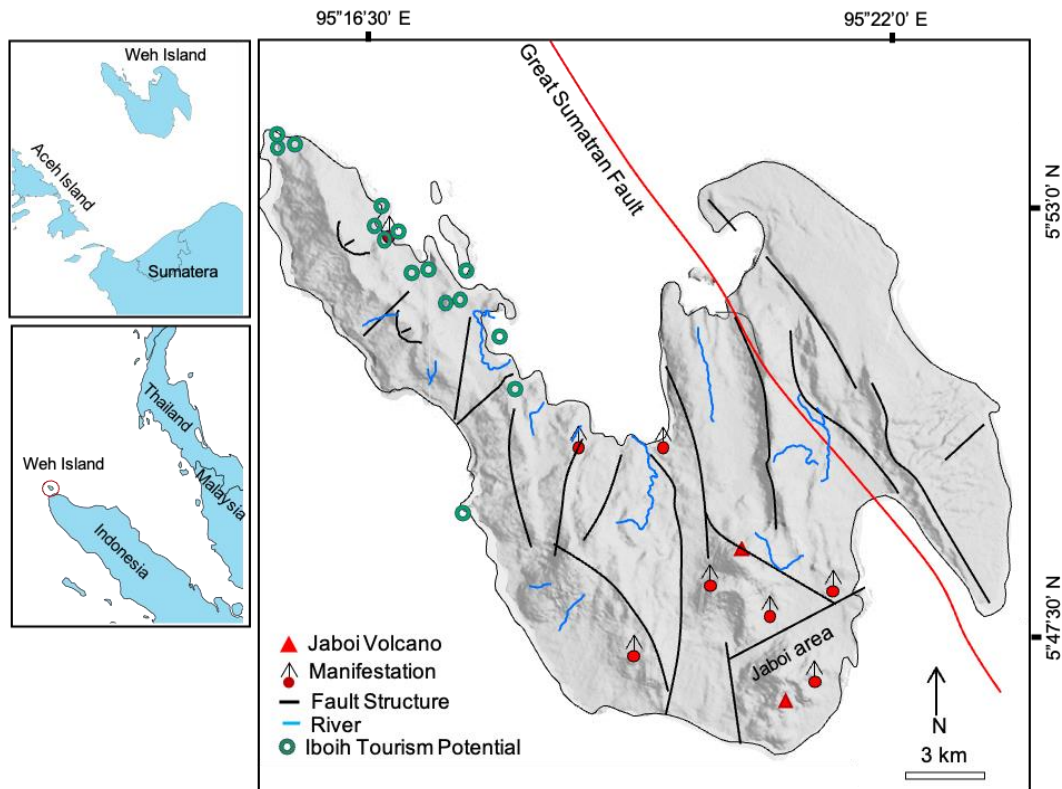


Figure 2. The map of Weh Island provides information on the distribution of faults that can pose a hazard but also presents several geological landscapes for geo-tourism development, as indicated by the green symbol as a representation of the tourism potential of Iboih. The data on Iboih tourism potential were visualized through information from the local government administration, while the manifestation data was obtained from direct field observations (Yanis et al., 2022)

Geologically, on the island of Weh, several faults have the same direction as the GSF, namely NW-SE. This system then forms segments and is accompanied by volcanic activity in the form of the Jaboi volcano (Dirasutisna and Hasan, 2005; Marwan et al., 2019; Yanis et al., 2022). Geologically, the volcanic area on Pulau Weh is a stratovolcano type located in the southeast, which is formed by andesitic and basaltic rocks (58%), volcanoclastic rocks (30%), and coral reefs and alluvium up to 12% (Dirasutisna and Hasan, 2005; Kurnio et al., 2016).

Therefore the geological object on Pulau Weh has great potential to be developed as a tourist location that prioritizes natural landscapes, and this is widely applied to developed countries to provide direct economic improvement to the community. Usually, an explanation of the geology at tourist sites is very important in the development of geo-tourism, but a special guide can only do this, therefore in this study we combined QR-Code and Web base programming in various languages for tourism transformation in digital form.

Basic Theory of Digital Technique

QR-Code

The most important point of QR-Code technology is accelerating the flow of information by using a smartphone camera to read the presented code. The QR-Code is considered one of the most influential visual factors to accelerate the flow of information in digital media. It is defined as an image bridge that can be embedded in a physical environment and has the capacity for storing data up to 2953 bytes which can be processed quickly. This system is an innovative development of standard barcodes (Solima and Izzo, 2017). In 1994, QR-codes were developed by a Japanese company called "Denso Wave" to follow vehicles in the production process and carry out inventories in the automotive industry, where this technology was released to the public without a license to generate codes for free (Marwan et al., 2020; Tangit and Law, 2021). Therefore, QR-Code has been widely used in its home country, Japan, and several countries for various purposes, such as tourist information management. This QR-Code has been considered a free, simple, and

effective tool in multiple fields. QR codes allow users to extract data in three modes: online, offline or combined. For example, users can use QR codes to connect to certain websites, send emails or read SMS on the device, save contact numbers, find GPS coordinates, listen to audio, watch videos, etc. (Cellaletin, 2017).

Web-based Programming

Several web-based languages are used in developing web-based applications, such as web servers, HTTP, MySQL, and PHP, which are integrated for different purposes. A web Server is software on the server to receive requests in the form of web pages via HTTP from clients known as web browsers and send back (response) the results in the form of web pages which are generally in the form of HTML documents (Franczuk et al., 2022). Hypertext Pre-processor or PHP is a web programming language on the server side. PHP is called server-side HTML-embedded scripting because all scripts in PHP are executed on the server side. PHP scripts integrated with HTML PHP are generally used to create dynamic web pages because PHP can generate and display the requested page simultaneously.

This mechanism makes users always get the latest pages from the website. Meanwhile, MySQL (My Structure Query Language) is a database engine often used in information system development (Ardito et al., 2019). MySQL has the advantage of fast and flexible management because it can be applied on various platforms. MySQL supports various data type formats, so it can be used to store data as needed (Nuanmeesri, 2021).

Web-GIS Technology

Web GIS is an application accessed through browsers such as Chrome, Mozilla, and Safari, which are available for various platforms. Depending on the capabilities of the software, users can display queries for geographic data analysis remotely via a web browser (Albuquerque et al., 2018). Web-based GIS is becoming one of the newest fields in Geographic Information systems for web-based map creation (Feng and Morrison, 2011). Different software and technologies are used to develop web mapping using commercial, open-source, and public software.

Commercial companies develop well-documented and licensed software with advanced features for commercial purposes, but the price for the technology is relatively high compared to open-source software. Open-source software systems are growing rapidly with the involvement of many people and can be used for free.

METHODOLOGY AND PLANNING

To achieve digital-based tourism management, we have integrated web-based programming with QR-Code and Web-GIS, which are implemented in Iboih Village, Sabang. This village has become the center for tourism development in Aceh Province, Indonesia. This QR-Code-based information board is integrated with the Iboih village tourism management system providing the number of visitors and modifying the links in the system. Specifically, the flowchart features and methods applied in developing digital tourism in Iboih are shown in Figure3.

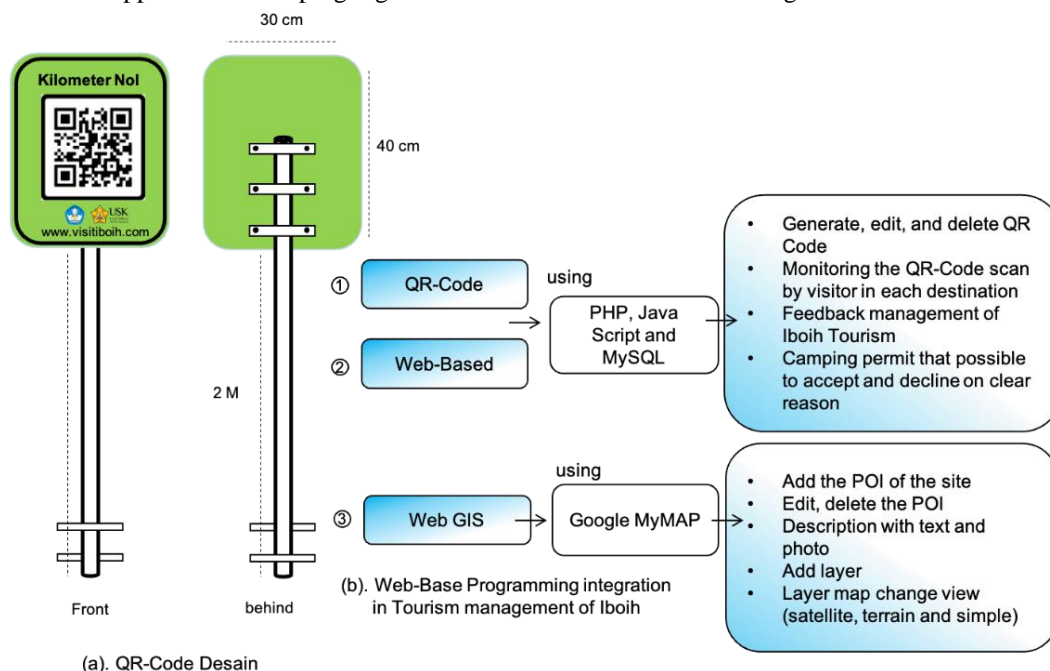


Figure 3. Integration of several technologies to develop E-tourism in Iboih Village, (a) a QR-Code model installed on each tourist site, while (b) showing a QR-Code-based web-based programming system and the features available in it

This dynamic QR-Code is used to modify the contents contained in the system without needing to change the QR-Code part. Developing a web-based system is designed to be as easy as possible so that community groups can use and manage it easily. Several features in the web-based include adding tourist sites, editing links in the QR-Code, feedback, and camping permits that allow visitors to obtain permits online. For Web-GIS, we use features from Google's My-Map, which would enable adding site locations and deleting and describing Points of Interest (POI) from tourist sites.

RESULTS AND ANALYSIS

QR-Code Installation

QR Code is a matrix of cells arranged in a dark pattern (logical '1') and light (logical '0') module pattern. Each QR code pattern consists of a function pattern and encoding region divided into several module patterns. Each pattern has a specific purpose for processing data readings, such as position detection, timing, pattern alignment, format, and version information. One way to present limited details is through a digital QR-Code that can contain data in the form of text, photos, and videos. This QR-Code is connected to the Iboih e-tourism system which provides complete information from tourist sites. Figure 4 shows documentation and diagrams of implementing QR code information boards at tourist sites in Iboih Village. In the initial stage, we installed digital information boards at six famous tourist sites, which include sea panoramas, caves, and cultural heritage. The information system of Iboih tourism can be accessed through <https://visitiboih.com/>, which has been developed with a CMS from WordPress to manage efficiently by the tour committee. For example, Iboih Beach (Figure 4a) is the main tourist attraction on Weh Island. This beach also has access to Rubiah Island.



Figure 4. Installation of QR code boards at several tourist sites in Iboih, Sabang, (a-c) a QR-Code board model installed, (d-e) the tour manager is scanning in front of the QR code integrated with the system

Various water sports attractions are provided at this location such as snorkeling, diving, and searching for dolphins. The location of the QR-Code installation is placed right at the tourist entrance gate to facilitate the transfer of information to visitors. When the QR-code board is scanned, it will be redirected to the link <https://visitiboih.com/pantai-iboih/> which includes various content such as videos guided with subtitles in various languages. Besides that, photos and text contain information about disasters and the dangers of life on the volcanic island. The same technique is also applied to other tourist sites such as the zero-kilometer (Figure 4b), a monument marking the westernmost territory of the Republic of Indonesia directly adjacent to the Indian Andamans. The Zero-kilometer memorial is a geographical marker of the region and has become a popular tourist destination on Weh Island. The position at the very end provides a landscape view of the open sea from the Indian Ocean. If the weather conditions are clear, Pulo Rondo will appear in front of it as the outermost island of the western tip of the State of Indonesia.

The Monitoring System of Iboih Tourism

E-tourism has a function to present information through QR codes created with the WordPress CMS. In addition, we have also developed this system to be user-friendly in terms of managing the QR code system, which provides features such as QR-code generation, editing and monitoring of visitors that scanned at the tourist location. This system was developed using several web-programming languages such as Javascript, PHP and MySQL database. Figure 5 shows the login page of the E-tourism system, which has been designed simply and is connected to a MySQL database so that only users who manage tours can access the system. Specifically, this system can be accessed via the link <https://monitor.visitiboih.com/user/login>.

After inputting the username and password, it will present several valuable features for QR-Code management, such as a monitor menu that aims to see the number of users who have scanned the code at each tourist location, making it possible to see the number of visitors. In addition, the QR-Code applied here is dynamic so that it can replace the links available on the QR-Code in the form of web, images or videos without changing the barcode display. This is done to be more economical and save time in changing information at each tourist site. This method combines Javascript and PHP to manufacture an API that generates a QR code based on a fixed link. This link redirects the information we input into the

system so that the link from the QR-Code that has been degenerated only serves to direct the link to the intended information. At the initial stage, we put all the information together on a website that presents videos, photos, and text in various languages. Specifically, the display of the system for generating and editing QR-Code links is shown in Figure 6.

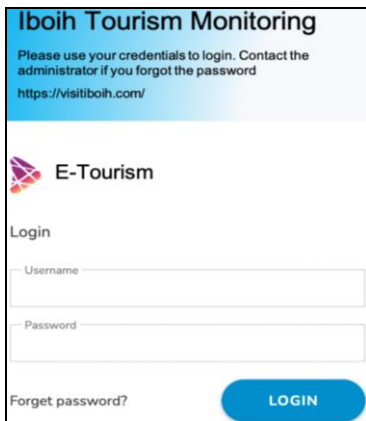


Figure 5. Login form developed with JavaScript and PHP for managing and monitoring visitors who scan QR codes at Iboih tourist sites. Login information is only given to the Iboih tour manager admin

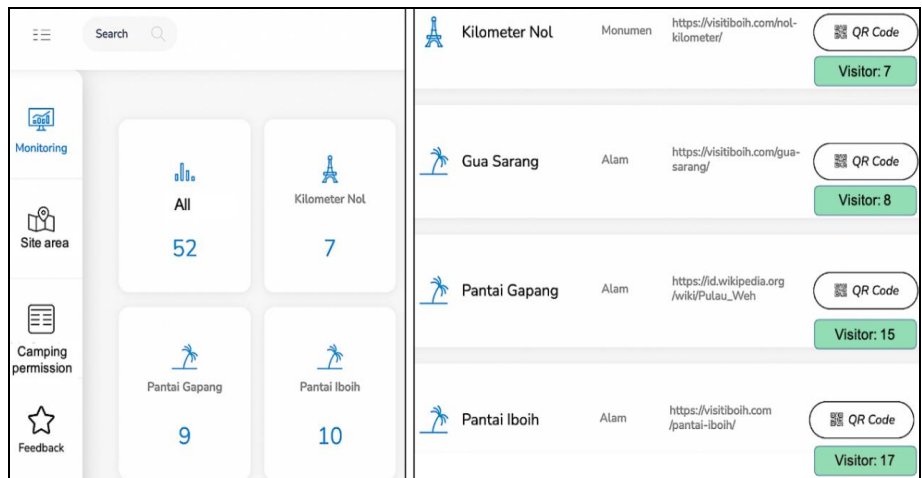
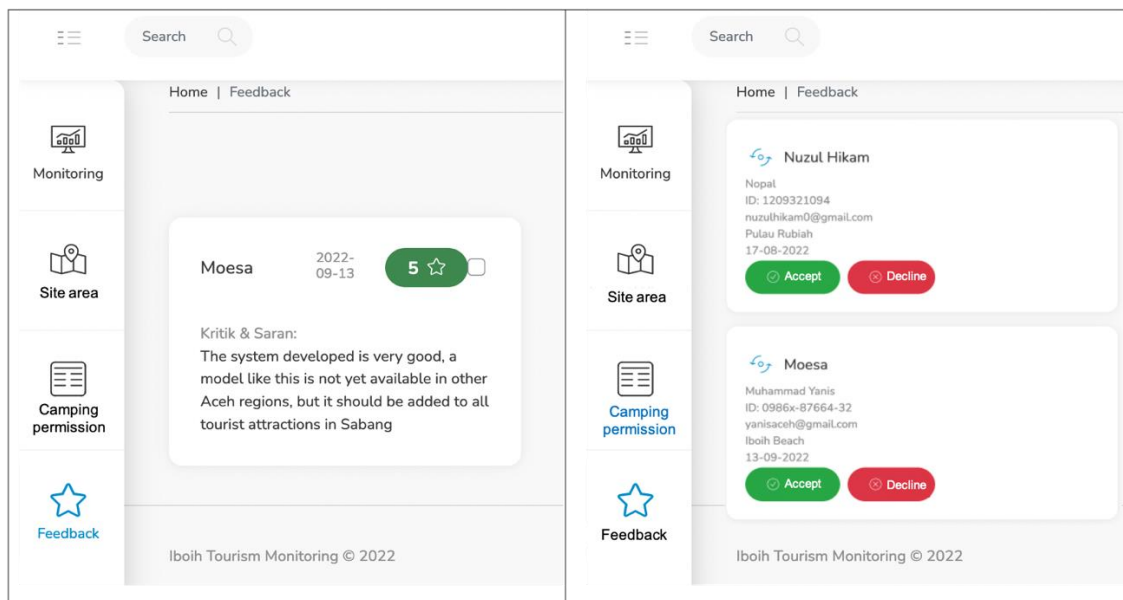


Figure 6. (a) Display of the system's homepage that presents the available features for monitoring Iboih tourism, (b) display of the monitoring feature that shows the number of visitors on each tour and allows for content editing without changing the QR-code model

In order to provide feedback to tour manager for better tourism development, the E-tourism system also has a feature for monitoring feedback. This is a helpful feature to give the opportunities for visitors to provide suggestions and criticisms for Iboih Village tourism improvement. The input form for the feedback can be accessed at the link <https://feedback.visitiboih.com>, and it is available on the QR-Code information board and the Iboih information center. Furthermore, we also developed a digital camping permit request system for visitors to apply for permits easily. Previously, visitors had to process permits manually, taking a relatively long time; the form permit can be accessed through <http://izin-camping.visitiboih.com>. This camping permit will be sent to the Iboih e-tourism system and can be accepted or rejected by the admin. The verification results will be sent to the visitor's email automatically. Specifically, the visualization of this system is shown in Figure 7.



(a). Monitoring for Feedback in the tourism site

(b). Monitoring for camping permission in Iboih tourism

Figure 7. The Iboih e-tourism system also has a menu for managing visitor feedback and can be viewed by the admin through the Iboih e-tourism application. Furthermore, there is also a menu requesting a camping permit.

WEB- GIS OF IBOIH TOURISM

A geographic information system is a helpful tool in tourism management that can analyze spatial and non-spatial data in an integrated manner. Developing a system that can support the decision-making process in tourism and allows visitors to get an overview of the diversity of tourism resources, products, and services is the primary goal of applying GIS in the tourism marketing (Vu et al., 2015).

In this study, we use Web-GIS to show Iboih tourism resources everyone can access via a browser platform link. We use the My-Map system from Google Inc., which is open source and has a user interface, making it easy to develop web-GIS tourism in Iboih Village. This system allows for adding site locations, deletion, and description of Points of Interest (POI) from tourist sites. This system can provide several important locations from Iboih Village, such as (1) a general site that contains the location of mosques, government, banks, schools, etc., (2) accommodation locations that provide complete lodging information with prices and telephone numbers, to make it easier for visitors to directly booking, (3) food and cafeteria locations and (4) tourism sites in Iboih Village.

Each Point of Interest (POI) category is given a different label and icon; road information is integrated with Google Maps. One can choose various base layers map models such as Earth view, a topographic that presents road information and a hybrid that combines both models. In total 160 locations we have filled in the web-GIS system, where each site is described in English. This system can be accessed via <https://visitiboih.com/web-GIS.html>, as shown in Figure 8.

Response of the Iboih community

To improve human resources in Iboih Village, we also disseminated the application of QR codes in tourism management. This activity involves students with various fields of knowledge to provide a better approach to people with diverse backgrounds. The main target of this activity is a tourism group as the person in charge of tourism sustainability in Iboih Village and for the community whose primary income is from tourism activities.

It is carried out with several approaches to increase public knowledge of the application of digital-based tourism management. We also analyzed the response of tourist visitors to the application of digital tourism in Iboih Village through a questionnaire. There are 48 respondents from different backgrounds.

Specifically, the results of applying QR-code and web-based for digital tourism are shown in Figure 9. Based on visitor analysis, 31 people or 65% chose that implementing the QR-code system was very effective and helpful for developing digital-based Iboih tourism. In contrast, 21% answered a Bad Idea and responded with no opinion for 15%, indicating a lack of knowledge about the system. However, some countries have integrated the QR-code system into tourism development, including presenting information in museums. Meanwhile, regarding the application of the Web-GIS system, feedback management and camping permit, 21 people or 44% answered a good idea that the system is helpful in Iboih tourism development, and bad ideas 17%, and those who chose no opinion were relatively the same, namely 40%. This is because many visitors do not know about the efficiency of web-GIS technology, so many respondents choose no opinion. In contrast, for general technology that has been widely used such as video, photo and text, 83% or 40 people choose that data obtained after the visitor scans the QR -Code is very informative and useful for digital-based Iboih tourism development, only 13% or six people choose no opinion, and 4% choose a bad idea. The analysis results obtained from these respondents indicate that implementing QR-Code and web-based programming is very effective for developing digital tourism in Iboih. Still, it is necessary to disseminate information to the public and visitors to implement this system perfectly.

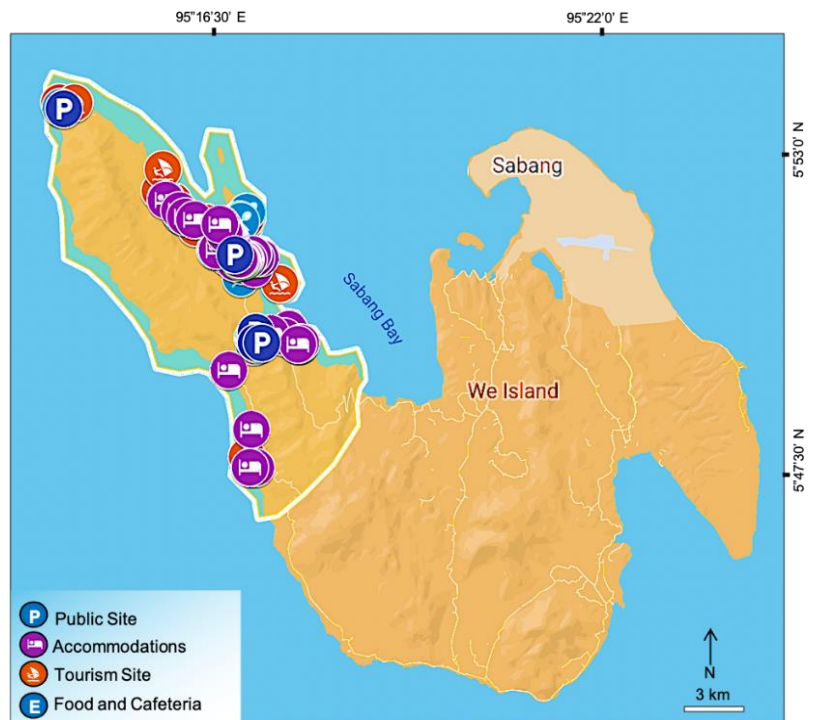


Figure 8. The webGIS application window developed by the Service Team in Iboih Village presents important information from Iboih village, divided into four categories: public information, tourist locations, accommodation, and cafeteria information. The point of interest data in Web-GIS was obtained from local government and field observations

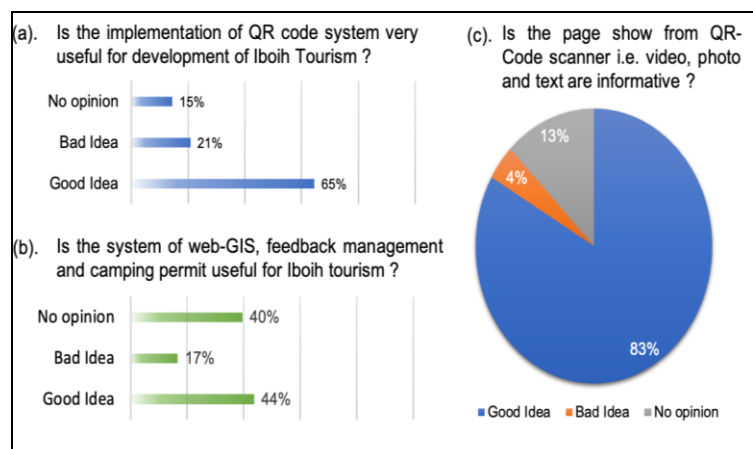


Figure 9. Response analysis from visitors to the application of QR - Code and web-based programming for tourism development in Iboih Village

CONCLUSION

Digital marketing is one of the cheap tourism promotion methods that everyone can access easily with various platforms. We have implemented several QR-Code technologies and web-based programming to develop digital tourism in Iboih village, Weh Island. The QR-code information board provides unlimited information in various languages through videos, photos and text. This system is integrated with the Iboih tourist information center developed with WordPress CMS. In addition, the number of visitors can be monitored through a QR-Code visitor scanner integrated with the e-tourism system built by combining web-based programs such as java-script, PHP and MySQL. We also visualized the Point of Interest (POI) of Iboih tourism using a simple Web-GIS from Google Inc's MyMap, allowing us to create and edit layers and add other POIs. Based on the questionnaire analysis given to 48 visitors, 65% answered that the QR-Code system was helpful for tourism development in Iboih Village. Still, there was no opinion answering 15% which indicated that the public in general needed to be more familiar with digital systems for tourism. Hence, socialization in the community is one effective solution to increase visitor knowledge of the system that has been implemented. We conclude that integrating the QR-Code system with web-based technology is an effective and inexpensive method for transforming digital tourism, which can be applied to other parts of Indonesia.

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