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Web-based Geographic Information System for Tracking Biosecurity Measures in Malaysia's Fisheries

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Abstract

Background

Web-based apps have evolved as a result of technological and security developments. Traditional software-based systems and applications can be rapidly upgraded by transitioning to a web-based implementation. A web-based system is a piece of software that users may access from any internet-connected device, such as a computer, tablet, or smartphone. Some form of geographically dispersed data is the foundation of a web-based GIS. This collection of technologies serves as the conduit for data transfer between the client and the GIS server. Instead of keeping track of their connection in local storage, it is transmitted over the network by means of uniform resource locators (URLs) generated by the server and transmitted via the hypertext transfer protocol (HTTP).

Objective

This study aims to improve fisheries biosecurity management and monitoring with the help of remote sensing and related technologies like GIS and ICT by doing this research. Also included are the necessary documentation, user guide, and training for web-based GIS applications, as well as User Acceptance Testing (UAT). This technology was developed in accordance with a MoU signed by the Malaysian Space Agency (MYSA) and the Malaysian Department of Fisheries (DOF) on November 27, 2018.

Methods

When viewed at a resolution of 1280x1024, the bioDOF-Map system is at its best as a web-based mapping and navigation tool, compatible with Internet browsers like Google Chrome and Mozilla Firefox. An online mapping application was developed with the help of Arc GIS Server. The widgets, tools, and capabilities of GIS software make it simple to finish the search and analysis process.

Keywords: web-based mapping, spatial, GIS, Remote Sensing.

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Introduction

Distributed spatial data is the backbone of web-based GIS. Connectivity between the GIS server and the client relies heavily on this configuration of cutting-edge services. Using HTTP and URLs generated by the server, they are able to exchange information (for the customer). Commonly used Web-based GIS analysis options include spatial analysis, improved mapping, and access to spatial information. Web-based geographic information systems (GIS) that enable more sophisticated and interactive planning have seen rapid growth in recent years [1]. More and more people are using the internet to gain access to state-of-the-art planning and geographical analytic tools and spatial data. Therefore, the goal of any information system should be to improve the quality of decision-making [2]. Users will benefit from being able to easily do searches, conduct analyses, and print out reports or maps thanks to the implementation of an interface system [3]. A online GIS can be accessed with any modern web browser, such as Google Chrome, Mozilla Firefox, or Internet Explorer. The purpose of this research is to improve fish management and monitoring through the increased application of remote sensing technology and related technologies like Geographic Information Systems (GIS) and Information and Communication Technologies (ICT). Documentation for the User Requirement Specification (URS), design, development, production, installation, testing, and delivery of a web-based GIS application, including a user acceptance test, are all part of this process (UAT).

The DOF-MYSA Memorandum of Understanding (MoU), which was signed on November 27, 2018, served as the foundation for the system that was built. GIS ArcGIS Server is utilised in the creation of web services, application development, and the management of spatial data. It is a back-end server programming component of ArcGIS Enterprise that makes geographic data available to other people within the organisation as well as anybody else with an internet connection. The purpose of the servers' design was to provide support for the structure so that it could develop and distribute unified GIS apps and assistance to satisfy a variety of criteria based on the demands of users.

Associations use ArcGIS Server to provide maps and spatial data framework (GIS) capabilities through web-based mapping applications and services in order to work on internal work processes, transmit crucial data, and communicate with others. This allows the associations to work on their own work processes, transmit important data, and communicate with others. ArcGIS Server is utilised by individuals so that they can effectively deliver GIS applications all through and beyond their project. ArcGIS Server integrates with the wider IT environment, which enables the benefits of spatially enabled data to be communicated to a greater number of people at a lower cost. Additionally, ArcGIS Server is able to manage terabytes of data while providing improved spatial data security and reliability for data resources.

Methodology

Data Collection

A Memorandum of Understanding (MoU) signed by the DOF and MYSA on November 27, 2018 served as the basis for the resulting system. GIS The creation of online services, apps, and spatial data are all made possible with the help of ArcGIS Server. Using this feature of ArcGIS Enterprise's server-side programming, your organization's geographical data can be shared with anybody else in your company (or, if you so choose, anyone with an internet connection). The servers were built with the intention of providing infrastructure support,

allowing the organisation to create and disseminate unified GIS apps and assistance that meet a wide range of user requirements. When it comes to providing maps and spatial data framework (GIS) capabilities via web mapping apps and services, many businesses rely on ArcGIS Server.

Because of this, the organisations are able to collaborate on internal processes, share critical information, and communicate with outside groups. People will use ArcGIS Server to efficiently distribute GIS applications during and after the project's duration. Because ArcGIS Server is integrated into the larger IT ecosystem, the benefits of spatially enabled data may be disseminated to more individuals at a cheaper cost. As an added bonus, ArcGIS Server can handle terabytes of data while bolstering the safety and reliability of your data resources through enhanced security for spatial data.

Data Verification and Integration

Integrating geographical data with the agricultural systems perspective allows us to analyse the relationships between farming communities and their physical environments (K.C,2005). Integrating key socioeconomic and spatial data allowed researchers to better understand the role that geography has played in shaping modern agricultural practises. Hotine's ellipsoidal oblique Mercator projection is in use in Peninsular Malaysia. and he labelled it the RSO projection, or rectified skew orthomorphic. The projection's beginning line, which begins at a coordinate of 4°00'N and 102°15'E, has an azimuth of 323°01'32.

Before getting the cadastral and any digital maps, it was essential to verify that the specified references projection was accurate and proper in the correct order. Kertau 1948 was utilised as the projection in the investigation. Since 1948, the Malayan Revised Triangulation has been used for geodetic, cadastral, and other purposes throughout Peninsular Malaysia. There are a total of 837 secondary stations, 240 main stations, 77 geodetic stations, and 51 tertiary stations that make up this network. Several triangulation stations using the April Layout, which relies on standard observations, are included in this network. MRT 1948 was implemented after recalculations of the preexisting network and the Primary (Repsold) Triangulation between 1913 and 1916. The MRT 1948 datum origin was also located at Kertau, Pahang at o = 03° 27' 50.71" North, o = 102° 37' 24.55" East of Greenwich, and the reference ellipsoid used was the Modified Everest with a = 6,377,304.063 m and 1 /f = 300.8017. It was the late Brigadier Martin Hotine who developed the Rectified Skew Orthomorphic (RSO) map projection for use on Peninsular Malaysia and Borneo (Clifford, 2009). Once the correct projection has been applied to the map layers, the next step is to double-check the data included in each layer. Data attributes illustrate the significance and accessibility of map features.

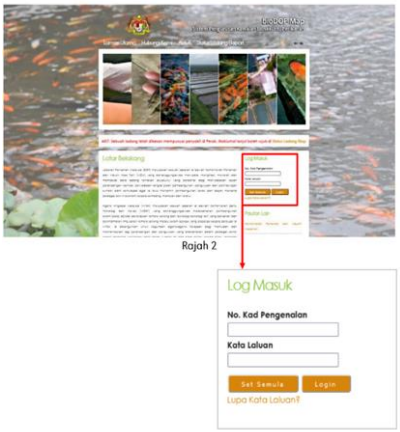
Results and Discussion

With web apps, it doesn't matter what kind of computer (or tablet) you have, or what kind of operating system you use. The browser plays a crucial role. The web software works on any browser, regardless of the user's operating system (Windows XP, Windows 10, Mac OS, or Linux). It's true that not all browsers are compatible with each other. However, programming for various browsers is typically simpler than programming for many OSes.

Moreover, the user interface will likely feel more natural to them.Users are urged to use internet rates greater than 520Kbps. Users who wish to use this system must also adhere to a certain basic system requirements. The ideal computer resolution for browsing the system is 1024 x 768 pixels. Whereas, this study identified that the bioDOF-Map system consists of five modules such as view, search, edit, measurement and tools. Only registered users will be able

to login to the Web-based system. The login authentication system is very common for any web application, for data security purposes. It allows registered users to access the website and members-only features. It is also helpful when we want to store information for users of the system (Figure 1).

Fig. 1: *Login page to the bioDOF-Map system by entering registered username and password.*



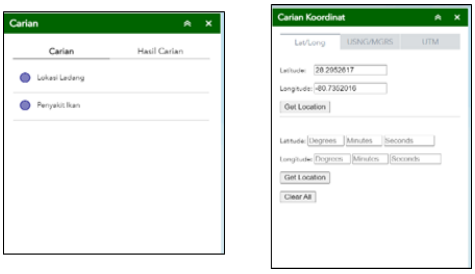
The initial part of the system allows you to see where all the fish farms are. Access to the system is granted to users so that they may retrieve information from designated farm buildings. The system's spatial data can be broken down into two broad categories: basic information and aquaculture farm information (Figure 2). The zoom in/out, home/my location, pan/full view/bookmark functions (shown in Figure 3) were developed to facilitate user navigation.

Fig. 2 : *Distribution of farms in the system, table of basic related information and aquaculture farms information.*

Fig. 3 *Bookmark*

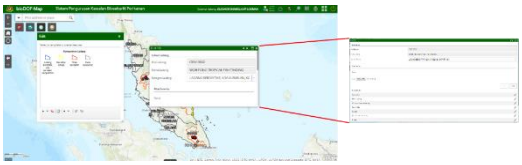
In the second module, searches were divided into two types: broad searches, such as those for farms and fish diseases (Figure 4), and narrow, targeted searches, such as those for specific coordinates, for easier location finding in the system (Figure 5).

Fig.4 and Fig. 5 *: General search and specific search in the system.*



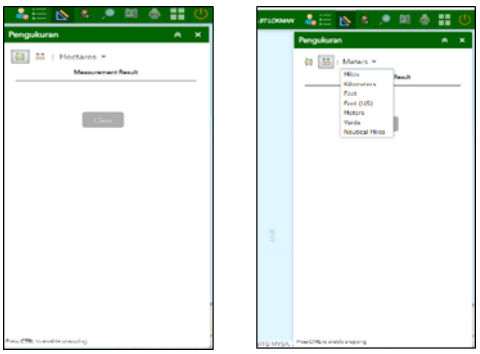
Third, there's a widget for editing information that may be accessed by the system administrator. This widget should only be used by authorised users who have been given access to edit spatial data (Figure 6).

Fig 6 : *Edit widget*



In the fourth section, an administrator can access a measurement widget that, among other things, determines the distance between two spots or the size of a farm within the metric system's optionally selected range of values (Figure 7). It's a simple way to estimate distances that's vital for mapping tasks. The distance between cities and individual farmland is one variable that could prove useful in network analysis.

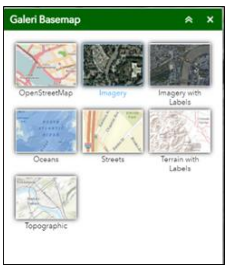
Fig 6 :*Measurement widget*



Finally, the module concludes with printing widgets that make it easy to publish the results of the analysis in the form of tables and maps (Figure 8). This method allows the user to display their favourite basemap gallery, such as Open Street Map, Imagery if labeled, or Topography map (Figure 9).

Fig. 8 *Printing result from system*

Fig. 9 :*Basemap Gallery option*



Geographical information, both with and without a corresponding physical location, and any other data identified as being relevant to this information can be collected, stored, and analysed quickly and securely using Geographical Information Systems (GIS). For the most part, there are two ways to collect information: To be used in a GIS project, secondary data sources must be converted from their original digital or analogue formats into a more acceptable one. When working on a GIS project, it is essential to have access to primary data sources that have been collected digitally. Apps, like the edit widget in the system, provide the most accurate means of modifying GIS data and the accompanying information.

GIS data can be collected using a variety of methods, such as to better comprehend Earth's surface and solid Earth processes, spatial data can be represented through geovisualization, which aims to make observational and simulated datasets more readable [5]. Another user-driven and smartphone-based application is LBS (Location-Based Services). Whenever the manipulator is used, the gadget is able to pinpoint its exact location. There is an option for the user to modify this location if they believe it to be inaccurate. And VGI, or Volunteered Geographic Information, is a new tool that enables anyone with a smartphone to contribute geographical data and enhance our understanding of any region. It happens on social media platforms [6].

The app is compatible with a wide variety of sensors and sensor interfaces, including in-car GPS systems and mobile device providers. The programme can be used to incorporate live data into GIS programmes. It can connect to common sensors and feeds, including in-car GPS systems, and smartphones offer a stunning array of real-time filters and analytical capabilities. The client benefits greatly from enhanced awareness of crucial appointment times, locations, and due dates for projects.

One can now chose from a number of tools and apps for field prospection, which is defined here as the discovery and documenting of newly developed aquaculture farm sites on a regional scale. More and more engineers are showing an interest in mobile apps since 2013[7]. The new equipment and programmes facilitated more accurate on-site estimations and streamlined administrative tasks [8].

The app can be updated to the most recent standards by being used and shown on smartphones, tablets, and watches. Wireless technologies are commonly used to describe the networks that enable these devices to communicate. Mobile phone users are able to communicate with one another and share resources such as apps, data, and voice calls (mobile apps). When it comes to advancements in GIS, mobile devices like smartphones and tablets play a similar role. However, the effectiveness of a mobile GIS depends on three factors: system performance, user interface design, and geographic functionality [10]. Web GISs are widely used to combine geospatial data and provide robust information analysis to end users via geovisualization or animation with interactive, web-based spatial web portals; however, mobile portals are not as commonly available. The use of GIS applications and information

acquisition in general are both greatly enhanced by the two types of devices. Tools like Collector for ArcGIS allow users to gather data and update information while out in the field using their smartphones. Mobile device apps can now take advantage of in-built GPS to better direct users [9].

Users may one day be able to bring their GIS with them from the office to the site using the ArcGIS programme. You can explore maps and collect information for reporting and GIS analysis using an app that you can get for free from Google Play, the Apple App Store, the Amazon App Store, or the Windows Phone Marketplace. The app's Runtime SDK allows users to build their own unique mobile programmes with a focus on development. ArcGIS Online map views and client-side service manipulation are just two examples of how the ArcGIS Application may be used to quickly find and supply the information you need. You can tailor a Geographic Information System (GIS) to your business's needs by editing, collecting, and updating geographical features and attributes; using tools to look, distinguish, measure, and execute a query; creating a bespoke application; or branding your own application.

Web-based applications have less complicated installation and maintenance processes, and the newest software can be easily deployed. When a new version or upgrade is installed on the host server, all users have immediate access to it without having to update their own computers. Based on online surveillance data updated by state fisheries officials, the bioDOF-Map system can currently assess the spread of illness. The dashboard will be updated to reflect the presence of notification icons.

An analysis module might be added to the system in a later update. Users of the bioDOF-Map system need not need extensive understanding of GIS or the usage of GIS software in order to use a GIS data collection that comprises information about a farm, other services, and related information.

Conclusions

Some benefits of GIS web mapping include shortened turnaround times, improved cross-departmental collaboration, easier access, and the linking of multiple structured data sources. Companies often find that after adopting web-based solutions, their internal operations become more streamlined. In many cases, paper-based processes can be replaced by digital ones that employ workflow-based solutions. Changes to the company's processes may boost employee output while decreasing expenses. Web-based applications can be distributed without requiring the client's PC to have specific software installed. Only the addition of a new user and the implementation of appropriate precautionary access constraints is required. This may be especially helpful for seasonal businesses or startups. The process of adding or removing users is quick and painless.

Spatial analysis in real time is supported, The ability to access web maps remotely from any device, as well as publish and disseminate web maps with many feature layers and point locations. In addition, an IT professional oversees security, and web servers host websites' programmes. This eliminates the need for the company's sensitive information to be stored on insecure local client PCs. An employee who has access to a web application can view information even while they are not physically at work. No other data storage facility is required except from the dependable hub. Using this system, authorities and upper management at the Department of Fisheries Malaysia may better plan for and enhance facilities, which would in turn improve the quality of service provided to Malaysia's stakeholders. The need of

human resources is reduced, especially for management and monitoring purposes, and essential data on Malaysian fisheries, aquaculture, and fish illness is provided.

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References

H Hazrin, A Tahir, Y Fadhli (2014). Implementation of Web based GIS Application for Mapping of Health Facilities, Services and Providers in Malaysia. Global Journal of Computer Science and Technology.

Ozdilek, O. and Seker, D.Z. (2004). A Web-Based Application for Real-Time GIS.

Plewe, B. GIS online: Information, retrieval, mapping and theInternet. Santa Fe, NM: On Word Press 1997.

http://www.esri.com/software/arcgis

Mike J. Smith, Jan-Christoph Otto, Antoni B. Moore, Carlos H. Grohmann, John Hillier, Martin Geilhausen, (2021). Geovisualization. Reference Module in Earth Systems and Environmental Sciences, Elsevier. ISBN 9780124095489.

Elwood, S., Goodchild, M. F., & Sui, D. Z. (2012). Researching Volunteered Geographic Information: Spatial Data, Geographic Research, and New Social Practice. Annals of the Association of American Geographers, 102(3), 571-590. https://doi.org/10.1080/00045608.2011.595657

Google 2013 Visualize your data on a custom map using Google My Maps. Google Earth Outreach. Available at http://www.google.com/earth/outreach/learn/visu-alize-your-data-on-a-custom-map-using-google-my-maps/ (PDF) 2020. “Mobile GIS – Current Possibilities, Future Needs. Position Paper”. Available from: https://www.researchgate.net/publication/345778221_2020_Mobile_GIS_-_Current_Possibilities_Future_Needs_Position_Paper [accessed Dec 12 2021].

Campana, S 2016 Sensing Ruralscapes. Third-Wave Ar-chaeological Survey in the Mediterranean Area. In: Forte, M and Campana, S (eds.), Digital Methods and Remote Sensing in Archaeology : Archaeology in the Age of Sensing (Quantitative Methods in the Hu-manities and Social Sciences). Cham: Springer Inter-national Publishing. pp. 113–145. DOI: https://doi.org/10.1007/978-3-319-40658-9_6 (PDF) 2020. “Mobile GIS – Current Possibilities, Future Needs. Position Paper”. Available from: https://www.researchgate.net/publication/345778221_2020_Mobile_GIS_-_Current_Possibilities_Future_Needs_Position_Paper [accessed Dec 12 2021].

Zandbergen, P A 2009 Accuracy of iPhone Locations: A Comparison of Assisted GPS, WiFi and Cellular Po-sitioning. Transactions in GIS, 13: 5–25. DOI: https://doi.org/10.1111/j.1467-9671.2009.01152.x (PDF) 2020. "Mobile GIS – Current Possibilities, Future Needs. Position Paper". Available from: https://www.researchgate.net/publication/345778221_2020_Mobile_GIS_-_Current_Possibilities_Future_Needs_Position_Paper [accessed Dec 12 2021].

Roth, R. (2017). User Interface and User Experience (UI/UX) Design. The Geographi Information Science & Technology Body of Knowledge (2nd Quarter 2017 Edition), John P. Wilson (ed.).