ARPOS: Internet Mapping Technique for Web-based Remote Supervision of Artificial Reefs Positioning

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ABSTRACT

In upcoming years, the strategies for maintenance, traceability, management and operation of productive processes will demand the use of novel information and communication technologies. Supervisory systems in these new scenarios will have to be able to integrate large volumes of information and knowledge coming both from local and remote points of large processors. In the fisheries industry, Artificial Reefs is one of the most important devices for the conservation and sustainability of fish and their biodiversity to make sure that the species will sustain and retain. In this work, the authors present an internet mapping technique for web-based remote supervision of artificial reefs positioning that incorporates powerful data and knowledge visualization tools based on map. This architecture adds an intermediate layer (database) to well-known client and server layers that isolates the client part from the committee of the fishery bodies involved in storing data for artificial reefs positioning, and accessed and visualized it through on-line application.

Keywords:

Internet mapping, three tier architecture, visualization tools and remote supervision.

1.0 INTRODUCTION

"Overall, we are locked into a race. We must hurry to acquire the knowledge on which a wise policy of conservation and development can be based for centuries to come." (E.O. Wilson, 1998).

In the above quote, Wilson (1998) urges the global biodiversity community to develop a wise set of policies of biological conservation. Wisdom, in a systems analysis perspective, is the top portion of a hierarchy that also includes data, information and knowledge – the so called DIKW (data, information, knowledge and wisdom). In order to achieve wisdom, one must first have data – raw observations and measurements. Information is amassed when data are initially summarized or analyzed. Knowledge created when summarized is interpreted and used for decision making. Wisdom continued utilization of knowledge to guide behaviors into the future. Ultimately, the wisdom of our biodiversity decision making will be based in part on the quality of the data we have, on how effectively we can mobilize that data and tools to create knowledge, and how quickly we can achieve this goal given to biodiversity and conservation crisis (M. Dominguez, J.J. Fuertes and et. al. 2007).

Location is an issue in many problems that we must solve. Sometimes location issue is routine that we fail to notice it. For example, the alternative route that we take to work involves location issue but we do without realizing it. In some cases, location issue is a major concern that we make an effort to deal with it, such as redefinition of election boundaries. In many situations, location issue is recursive such as in the areas of artificial reefs site selection. Problems that involve location are termed as geographic problems (Taher B. 2007).

2.0 CURRENT SYSTEM

Viewing a location for Artificial Reefs is crucial to fisheries departments. Current system however doesn't seem to give a complete information needed by fisheries departments. The invention of Spatial Information system that can visualize the location in a form of map *via online* that can help fisheries departments to locate the Artificial Reefs distribution on their specific area based on *longitude and latitudes (Coordinate Data).* The current system doesn't display the exact location of Artificial Reefs in term of mapping system, doesn't have the automatic mechanism to update the Artificial Reefs distribution, cannot be accessed through online that consist of the timely manner which can suspend the entire decision making on the next Artificial Reefs positioning and distribution, and doesn't have the proper tracking and maintenance activities for the existing Artificial Reefs (M. Mustafa, et. al, 2007).

Thus, the research scope is to display and manage Artificial Reef at East Coast of Peninsular Malaysia Seashore. The location viewer is capable of navigating and also selecting the map and shows all information that referred to the Artificial Reef at the selected location. Therefore, developing a location viewer to display a depiction is significant since there is a need to have a system that can help fisheries departments to manage the distribution of Artificial Reef implementation (Mustafa, et. al, 2007).

The development of Artificial Reef Positioning System (ARPOS) is the idea that helps to manage the information involved in the fishery industries and as the result can increase the productivity and the quality on that particular sector. The objectives of this research are:

- *to collect and to analyze the requirements needed by the fishery bodies,*
- *to design the Total Spatial Information system on Artificial Reefs positioning system,*
- *to develop a prototype of Spatial Information System on Artificial Reefs positioning System and to evaluate the proposed system.*

3.0 WEB BASED REMOTE SUPERVISION DESIGN AND METHODOLOGY

Understanding the spatial data distribution of data from phenomena that occur in space today constitute a great challenge to the elucidation of central questions in many areas of knowledge, be it in health, in environment, in geology, in agronomy, among many others. Such studies are becoming more and more common, due to the availability of low cost Geographic Information System (GIS) with user-friendly interfaces (Blasby, D. 2006). These systems allow the spatial visualization of variables such as individual populations, quality of life indexes or company sales in a region using maps. To achieve it is enough to have a database and a geographic base (like a map of the municipalities), and the GIS is capable of presenting a colored map that allows the visualization of the spatial pattern of the phenomenon (Worboys, M. & Duckham, M. 2004).

This poses new scenarios in the conception of supervisory systems, where the amount of information we have to manage is several orders of magnitude larger than in traditional schemes. More adequate approaches according to the recent needs of productive processes require a proper management and integration of large number of variables, most of which can be located in remote places (for instance, number of fishery bodies in remote location in each region involve in managing artificial reefs positioning and maintenance data and record) (M. Dominguez, J.J. Fuertes and et. al. (2007).

ARPOS: Internet Mapping Technique for Web-based Remote Supervision of Artificial Reefs Positioning is the solution to cater this scenario. Below are the activities in designing and developing this application.

3.1 Knowledge Acquisition and Data Analysis

After identifying the problems and objectives, by using data collection methodology, the knowledge about GIS and Artificial Reef is acquired. Data are gathered from two main resources that define as primary and secondary data. The primary data consist of the map and data on the Artificial Reef implementation from LKIM. In data analysis phase, the collected data are analyzed to align with the scope of the research. This phase will summarize all data gathered and divided it into categories based on its similarities and priorities. In this phase also, the data needed in this ARPOS system are verified. The data used in the ARPOS are being identified through interviews on the focused topic on the implementation of Artificial Reef on East Cost of Peninsular Malaysia Seashore areas. This verification includes the necessary requirement and feature needs for the Artificial Reef positioning. The result of the findings on the analyzed data will be further used in the modeling the knowledge gained (Mustafa, et. al., 2006).

3.2 Knowledge Modeling and Representation

In this phase, the knowledge gained is modeled into understandable steps to be easily presented. Using the gained data, the spatial information is modeled and appropriate data are being selected for the spatial database. It's important to model the suit data on the spatial database application in order to make sure the application produced is accurately presented the actual position in the real implementation. It is significant to illustrate concepts and identifying the entities, attributes, attributes domain and others. There are several steps in modeling a database design process. The first step is to identify the conceptual data types, relationship and constraints for ER model. Then, conceptual model is mapped to logical data model. In knowledge representation, the conceptual and logical data model has been designed to represent the knowledge in an illustrative way. This includes the designing of conceptual model. The conceptual model is mapped to the logical data model for relational diagram. The representation involves in the form of ER diagram, relational schema and supporting documents. Each logical model is validated using normalization technique to ensure that the model is structurally consistent, logical and has minimal redundancy (Mustafa et. al., 2006).

3.3 Design and Implementation of Prototype

The prototyping methodology is used in demonstrating the spatial information system design on ARPOS. In designing the prototype, all requirements needed are identified. In this phase, it describes desired features and operations in detail, including screen layouts, business rules, pseudo code and other documentation.

In the implementation phase, the real code is written. All requirements of the technical stuff of the development are used. For example the language that will be used are PHP which integrated with the Map Guide® Autodesk application in presenting the maps and also Spatial Database Management System (SDBMS) such as MySQL database. The prototype done is implemented and run through specified configuration and evaluated thoroughly with respect to the requirements defined at the early phase of prototyping. The prototype is installed on suitable platform and a rapid development environment (Mustafa, et. al., 2006).

4. HOW THE LOCATION OF ARTIFICIAL REEFS IS VISUALIZED?

All location of Artificial Reef distribution on Malaysian's seashore and their related information can be managed and viewed by using the Artificial Reef Positioning System (ARPOS). The ARPOS prototype relies on typical three-tier architecture for enterprise information systems, composed of the client layer, application server layer, and the database layer (Mustafa, et. al., 2007).

This architecture focuses the load on the application server layer of the system, allowing for a thin client necessary context. All communications between the client layer and the database are conducted through the application server layer. With this type of architecture, the processing load is balanced, as each tier of the system resides on a separate computer (Figure 1). Also, the architecture allows for the development of individual components of the system separately, thus maintaining component independence (Comer, D., 2000).

In this way, different parts of the system can be developed at different stages; some more than others, without affecting the entire system each time a change needs to be made. For example, this architecture has proven to be ideal for developing Hypertext Preprocessor (PHP), Extensible Markup Language (XML) based applications because all PHP and XML processing is carried out on the middle tier of the system, without affecting client and/or database tier manipulation/development.

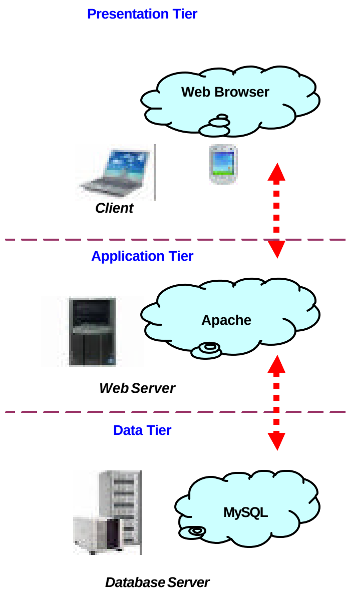

Figure 1: Tree-tier Architecture

4.1 Client Layer

The client layer of the system consists of a web-based, data-editing tool to provide the officers/user with capabilities to edit and annotate the data in the system. Initially, as the user navigates within a 3D model, the position and used to load data into the database and query for previously loaded data. Delivery of data to the client is a core research aspect of the project. For desktop web-based access, the content delivery is not affected by bandwidth restrictions.

In a client-side Internet GIS application, it requires user to install a complete client application. In either case client-side application require software of some kind (other than browser) to be transferred to the user. The client is enhanced to support GIS operations. To implement client-side solutions of any kind, software must be transferred to the client. The primary advantages of client-side solutions are the abilities to enhance user interfaces, improve performance and implement solutions using vector data. Client-side solutions can be implemented with all the features and capabilities allowed by a modern GUI (graphical user interface).

4.2 Application Server Layer

In a server-side Internet GIS application, a Web browser is used to generate server requests and display the results. An Internet GIS server usually combines a standard Web (HTTP) server and a GIS application server, and the GIS databases and functionality reside completely on the server(s). A server-side GIS application can be illustrated by a mapping application on any of the major Internet portals. Users type in the address they are looking for (the request), which is transferred to a Web server. The Web server passes the request to a GIS application server, which runs an address matching routine, generates a map graphic, convert the graphic to Web format, wraps the image in HTML and sends it back to the Web server, which are then returned the response to the client as a standard Web page. This is an advantage for simplified application development, deployment and maintenance of data. The application usually requires proprietary software and the software stay on the server. Map data transmitted to a Web client are in standard HTML formats that can be accessible through any Web browser, creating significant positive implications for performance, reliability and size of user base (Gilfoyle, L. & Thorpe, P., 2004).

The application server layer of ARPOS is responsible for formulating all spatial queries, inserts and updates to the system and acts as the main hub between the client and database. The Autodesk MapGuide LiteView servlet accepts HTTP requests for raster images through Java Servlet API interface of a Web Server as illustrated in Figure 2. To fulfill a request for a raster image, Autodesk MapGuide LiteView will:

- Accept an HTTP request for a raster image of a portion of an MWF file

- Load the requested MWF file
- Zoom to the correct location and scale, generating HTTP requests for a map-layer data to the Autodesk MapGuide Server.
- Return a raster image in PNG or JPEG format as the HTTP response.

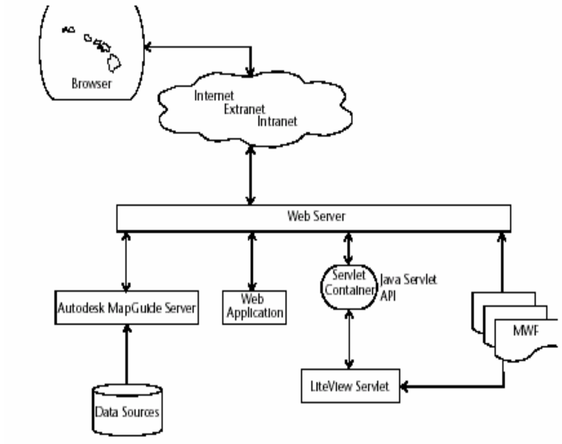

Figure 2: Application Architecture

4.3 Database Layer

The spatial database layer is responsible for processing all queries, both spatial and transactional, in the system. We are using Autodesk MapGuide LiteView that includes SDO, a spatial extension to SQL or MySQL. This database introduces new spatial data capabilities, e.g. geo-coding and topological queries. This tier stores all spatial and non-spatial data including raster (map) data and any metadata as well as the topological properties of these data. Spatial data types can be inserted, stored, manipulated and queried in the database as they are represented in physical space.

5.0 ARPOS: SOFTWARE USER INTERFACES

The ARPOS architecture is designed to help Lembaga Kemajuan Ikan Malaysia (LKIM) to manage the location of the artificial reefs and their activities. This software consists of the several modules for LKIM staff to insert, delete, update and modify all the artificial reefs distribution based on longitude and latitude of the artificial reefs. The artificial reefs will automatically be updated through online application and will also automatically be displayed in real time in the mapping by Autodesk MapGuide software as shown in the process flow in figure 3.

From the viewing screen of the mapping areas, this software also can display the distance between one artificial reefs to another artificial reefs. The radius of the areas of the distribution of the artificial reefs also can be displayed via this online software. Zooming technique in this software very useful for LKIM to modify and updated the information about the artificial reef [illegible] figure 4.

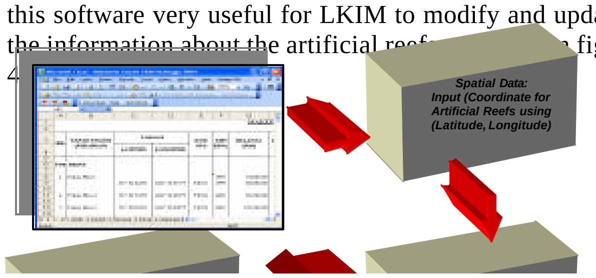

Figure 3: The Process Flow for ARPOS

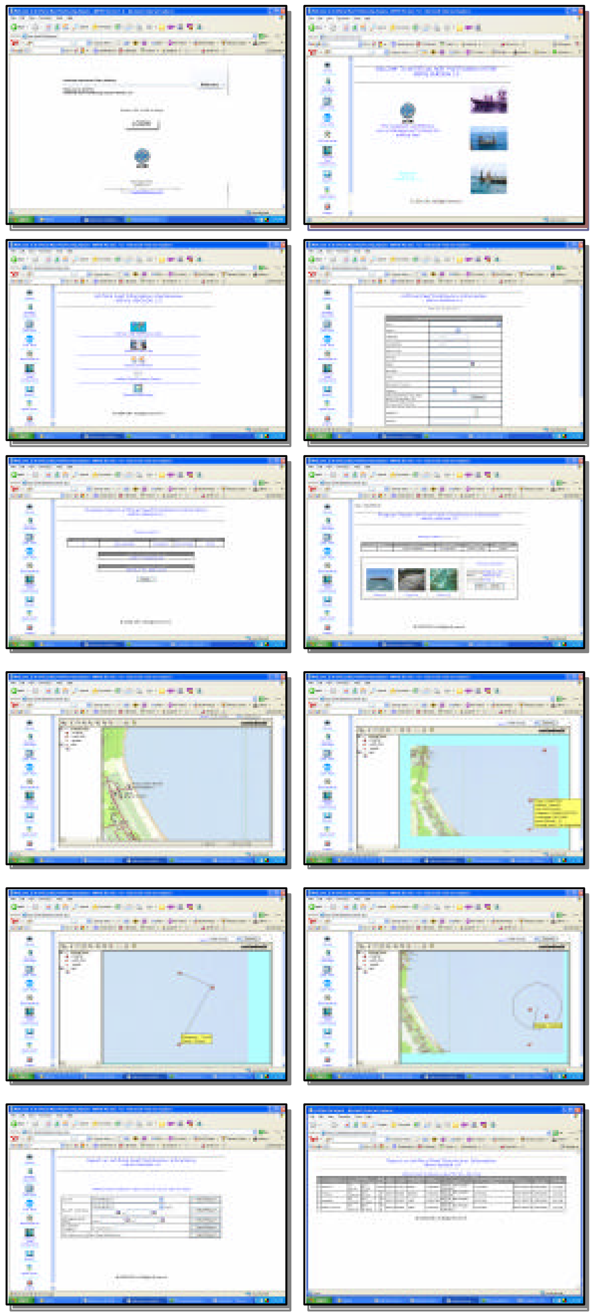

Figure 4: User Interfaces for ARPOS

6.0 CONCLUSION

This Internet Mapping Approach that is developed using open source software and integrated with Autodesk MapGuide visualization tools will guide the fisheries department in assessing and making the decision making for Artificial Reefs positioning and distribution, will provide an understanding of potential use of GIS internet mapping tools in Artificial Reefs positioning, and will help the researcher to visualize spatial data in presenting information instead of using relational databases.

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