Implementation of Y-Model GIS web development in inventory of environmental roads, drainage and septic tanks: A study case

C Fauzi*
Department of Computer Engineering and Informatics, Politeknik Negeri Bandung, Bandung, Indonesia

*cholid.fauzi@polban.ac.id

Abstract. Inventory of GIS Web Applications for Environmental Roads, Drainage, and Septic Tanks is an information system built to support spatial requirements, where these applications are built to address the problem of investing in environmental roads, drainage, and septic tanks according to maps. In developing a web-based GIS application, it usually uses the software development methodology but in this study, the application implementation uses the Y-Model Webgis Development (YWDM) which is a combination of web engineering and the context of developing web-based apps with a study case on inventorying spatial requirements on roads, drainage, and septic tanks. This methodology was implemented as a map visualization for city planning and development and is needed applications that are capable and appropriate. By using the YWDM methodology, the needs and accuracy of application development can be done well, using several tools. The data process uses tools, including ArcGIS ESRI, to create spatial data and PHP and JavaScript programming languages to visualize the results. The results show that application development is built more easily because requirements can be well defined because a collection of requirements from the context of software development and spatial specifications are met and the application is completed. When creating a GIS web application, some methodologies can be used besides waterfalls or ordinary SDLCs, because spatial requirements are not well defined. With the implementation of this methodology, it is proven that the development of GIS web applications can be easier and by the needs desired by the user.

1. Introduction
WebGIS is a GIS or digital mapping application that utilizes internet networks as a communication medium that functions to distribute, publish, integrate, communicate and provide information in the form of text, digital maps and carry out analysis and query functions related to GIS over the internet [1]. Meanwhile, the use of spatial data is increasingly needed for various purposes such as research, development and regional planning, and natural resource management [2]. Users of spatial data feel the lack of information about the existence and availability of spatial data needed. Spatial data dissemination that has been done using existing media which includes print media (maps), cd-room, and other storage media is felt to be insufficient for the needs of users. Users are required to come and see the data directly in its place (data provider). This reduces mobility and speed in obtaining information about the data. Y-Model Webgis Development should eliminate this by adding the spatial phase to obtain a requirement when building a web gis application. On managing city development, planning and development of
urban facilities can use technology. There are several road sections that are only 100 or 200 meters long. And the list of sections on this short road is too much, it turns out that it is in a residential road. Therefore, it is necessary to have WebGIS. Environmental Road is a public road that is in accordance with its function is a road that serves public transportation and is used by people with distance characteristics and short trips, including low travel conditions and roads (housing) are included in the District / City Road Decree [1-11].

2. Method

2.1. YWDM (Y Model Webgis Methodology)

Web GIS development is a combination of web development and GIS application development, both of which have their own complexities. Therefore, in developing the GIS web, it is deemed necessary to adopt a separate methodology, which is more complete than using software development methodologies in general. One of the WebGIS development methodologies ever proposed is YWDM (Y-Webgis Development Methodology). This methodology is a theoretical methodology proposed by Ananda, Curia, and Ngigi, which adopts a software development approach in general, a web development approach and GIS applications [12,13]. This methodology named Y is taken from the methodology diagram representation in the form of the letter Y. In YWDM, Web GIS development departs from two sides, namely the preparation of applications in terms of data and GIS technology, and in terms of web applications. Generally, the development phase is divided into 4 phases, which are then followed by the implementation phase. The implementation phase itself is further divided into several stages, namely integration of GIS data with web applications, optimization, testing, deployment, configuration and training testing, and system maintenance and updates [14,15]. Web service is a standard used to exchange data between applications or systems because applications that exchange data can be written in different programming languages or run on different platforms. Examples of implementation of web services include SOAP and REST. Web services based on REST architecture are then known as REST web services. This web service uses the HTTP method to apply the REST architecture concept.

![Figure 1. YWDM method and use case diagram based on functional requirement.](image-url)

2.1.1. Phase 1. Web GIS Development Line Planning and Problem Definition: how to prepare a spatial data that contains the boundaries of the research area, which in this research are environmental roads, drainage, and septic tank.

Web development line need assessment and discovery: there is a need from Research and Development in Inventory of Environmental Road, Drainage and Septic Tank to record research results
from area of Bandung City, which are visualized in the form of maps to support the evaluation of the information of each unit and identify requirement for planning and development in urban planning. Maps are also needed to estimate the scope of the work area of a unit, relative to other units.

2.1.2. Phase 2. Web gis Development Line Requirement analysis:

- The system can accept input in the form of a digital map file format (GeoJSON).
- The system can produce an interactive map of the research area that can be controlled by the user and can be accessed via the internet.

Web development line analysis business process:

Defining system requirements can be done after the business process analysis is done by looking at the user view. This need can be illustrated by use case diagram modeling. Use case diagrams illustrate system behavior related to interactions between actors and systems to achieve user needs. The actor in question can be a person or system. The use case is generated from the functional requirements of the user who has displayed the process business analysis table and is explained in the table below:

| No | Requirement | Functional |
|----|-------------|------------|
| 1  | FR01. User Management | Managing role access to application |
| 4  | FR02. Managing inventory of environmental roads, using local spatial data and maps service | Create Read Update Delete (CRUD) environmental roads, using data spatial |
| 5  | FR03. Managing light of environmental roads, using local spatial data and maps service | Create Read Update Delete (CRUD) environmental roads and light, using data spatial |
| 5  | FR04. Managing Drainage and Septic Tank, using local spatial data and maps service | Create Read Update Delete (CRUD) Drainage, Septic Tank Spatial Data |
| 6  | FR05. Reports | Create reports |
| 7  | FR06. View Maps | View Maps with layering |

2.1.3. Phase 3. Web gis development line database design: In designing this application, the class diagram used to describe existing objects in the application including the association of data spatial needed.

Figure 2. Class diagram of web gis environmental roads, drainage and septic tank.
Web development line conceptual and navigation design model:

The design of this information system uses YWDM with modeling using UML and application development using the programming language PHP, Yii framework and REST API. The architecture that is built ensures that functional requirements achieved and implemented. Every phase and process will be carried out. The architecture used in this study is MVC (Model View Controller) by using software development methods with the YWDM method.

![Figure 3. Model view controller.](image)

The view controller model is an architectural pattern commonly used to develop a user interface that divides the application into three interconnected parts. In its application, the MVC architecture supports the Yii framework for building website applications, this application also illustrates the association with REST that is shown as being applied [16].

3. Results and discussion
After the application was designed, it was built using the PHP programming language and PostgreSQL Database, and the MVC architecture with the Yii framework. Display applications as follows:

![Figure 4. Web gis environmental road, drainage and septic tank.](image)

As demonstrated above, spatial information represented graphically can be drawn from GIS solutions. Historical data of environmental roads, drainage, and septic tanks can be archived to support new decisions as a measure taken in monitoring and evaluation of decisions of urban planning. In the case of road, drainage and septic tank, it is possible to analyze, for instance, variables dependent on area, availability and shortage of water, reservoir conditions of drainage, contamination septic factors, troubleshooting of services and maintenance. All issues emerging from these can be analyzed and examined to aid critical decisions almost entirely from web-based GIS solution [8]. We can evolve the simple model used until now in another one that is more complex and can better model the web gis system. The prototype in this research worked fine, and it should be an idea to realize a system to continuously monitor the city and its conditions, using web gis service [17].

4. Conclusion
The following main conclusions of the research development of GIS Web Application Inventory Road Environment, Drainage, and Septic Tank, this GIS application becomes an example in web GIS research
that can be used in various fields, especially in the use of information technology both information technology itself and in the community [4]. This development can be achieved by applying the approach:

- The results of the analysis, design, and application of systems that can be accounted for and in accordance with user needs with the Y Model Webgis Development methodology.
- Designing a user-friendly application interface with web-based technology.
- Make optimal use of the existing application development architecture.
- The results of this research are concerned with the possibility of changes in the future.

We made these five things as references in this study. The existence of this activity is expected to be a solution to answer the challenges of the development of information technology and also to be a means of facilities to improve performance in the management of the object under study.

References
[1] Al-Bayari O 2018 GIS cloud computing methodology CITS 2018 - 2018 Int Conf Comput Inf Telecommun Syst. 1–5
[2] Grecea C, Herban S and Vilceanu C B 2016 WebGIS Solution for Urban Planning Strategies Procedia Eng. 161 1625–30
[3] Pollino M, Caiafita E, Carillo A, La Porta L and Sannino G 2015 Wave energy potential in the Mediterranean Sea: design and development of DSS-WebGIS “Waves Energy” In International Conference on Computational Science and Its Applications 495-510
[4] Fang Y I N and Feng M A 2009 WebGIS framework for vector geospatial data sharing based on open source projects Proc of the International Symposium on Web Information Systems and Applications
[5] Peng S Y, Ma W F, Yang K, Xu Q L and Huang B M 2010 A practical study on geographic semantic web services based on OWL-S 2010 Int Conf Comput Control Ind Eng CCIE 2010 2(10) 190–4
[6] Maocan Y, Tao L, Xiao W, Yunyang Y, Ronglin Ii and Quanyin Z 2017 Design of WebGIS system based on javascript and ArcGIS server Proc - 2017 Int Conf Smart Grid Electr Autom ICSGEA 2017 709–12
[7] Wang J Z and Li H D 2008 Research on the web GIS Technology Based on mapxtreme Proc - Int Conf Comput Sci Softw Eng CSSE 2008 2 123–6
[8] Mahbub M F, Jawad S and Ahmed S 2005 Geographical information systems and digital cartography in environment planning and development of Islamabad Proc - IEEE 2005 Int Conf Emerg Technol ICET 2005 370–5
[9] Ahmed K, Hassanien A E and Bhattacharyya S 2017 A novel chaotic chicken swarm optimization algorithm for feature selection In 2017 Third International Conference on Research in Computational Intelligence and Communication Networks (ICRICIN) 259-264
[10] Brovelli M, Negretti M and Biagi L 2017 Information System: Georeferenced Database In Research for Development
[11] Ali T A T, Saeed R A and Fageeri S O 2017 Web-based GIS Business Hotels Tourism Sites in Khartoum, Sudan Proc - 2017 Int Conf Commun Control Comput Electron Eng ICCCCCE 2017
[12] Ananda F, Kuria D and Ngigi M 2016 Towards a New Methodology for Web GIS Development Int J Softw Eng Appl.
[13] Pressman R 2015 Software Engineering: Practitioner Approach Book I (Yogyakarta: Andi)
[14] Rybalov N B and Zhukovsky O I 2007 Access to the spatial data in the Web-oriented GIS IEEE Int Sib Conf Control Commun SIBCON-2007 104–7
[15] Chawla S and Srivastava S 2012 Improving web requirements engineering with goals, aspects, and scenarios 2012 Students Conf Eng Syst SCES 2012
[16] Ollsson T, Toll D, Wingkvist A and Ericsson M 2015 Evolution and Evaluation of the Model-View-Controller Architecture in Games In Proceedings - 4th International Workshop on
Games and Software Engineering, GAS 2015

[17] Pine J C and Gupta R K 2014 Hazards analysis: Reducing the impact of disasters (United State: CRC Press)