Journal of Physics: Conference Series • *Open Access* • Volume 1823, Issue 1 • 31 March 2021 • Article number 012031 • 2nd UPY International Conference on Applied Science and Education, UPINCASE 2020 • Yogyakarta, Virtual • 3 November 2020 through 4 November 2020 • Code 168191

Document type
Conference Paper • *Bronze Open Access*

Source type
Conference Proceedings

ISSN
17426588

DOI
10.1088/1742-6596/1823/1/012031

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RDBMS dan Google Maps Integration Model for WebGIS Based Land Ownerships Data Visualization

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Abstract

Map-based visualization of land ownership data is much needed by policymakers, both in government and private institutions. The utilization of this data is primarily to support macro planning, policy-making, and good governance. On the other hand, there are currently many application systems available which are the RDBMS database. This research examines the proposed RDBMS integration model and Google Maps maps to visualize land ownership data in a dynamic map view. The prototyping method is applied in this study to show how the available RDBMS can be improved to visualize land ownership data in a WebGIS-based application. The proposed model is tested using an application prototype. Technically the model can be implemented without significant constraints, but the actual implementation still faces obstacles, especially related to policies related to the cross-sectoral utilization of population databases and the obligation to maintain data confidentiality.

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SUBJECT AREA AND CATEGORY

Physics and Astronomy
Physics and Astronomy (miscellaneous)

PUBLISHER

IOP Publishing Ltd.

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PUBLICATION TYPE

Conferences and Proceedings

ISSN

17426588, 17426596

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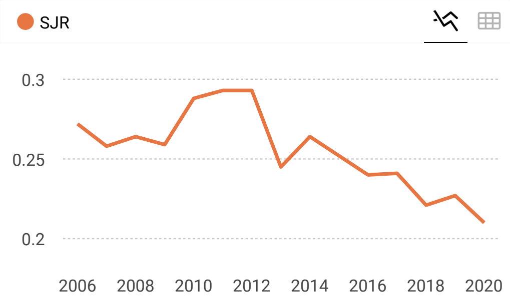

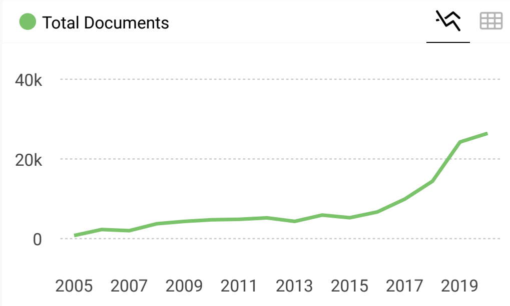

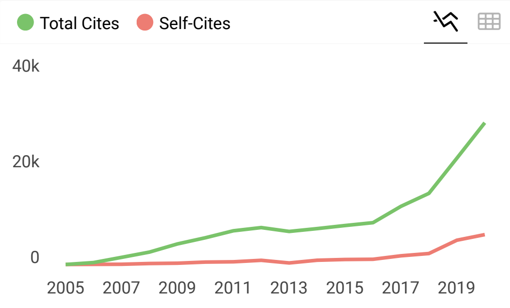

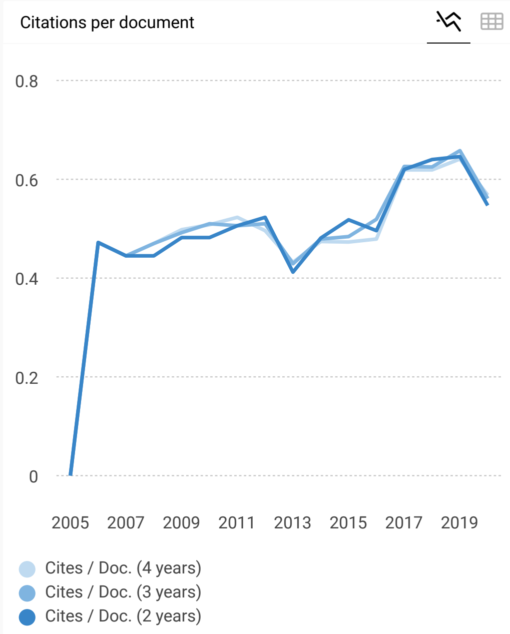

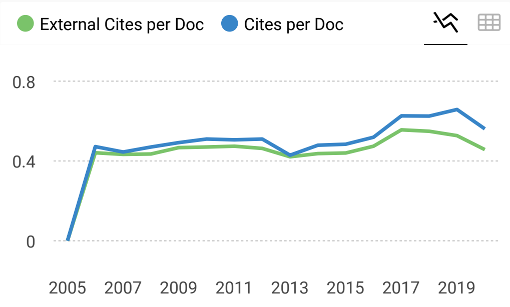

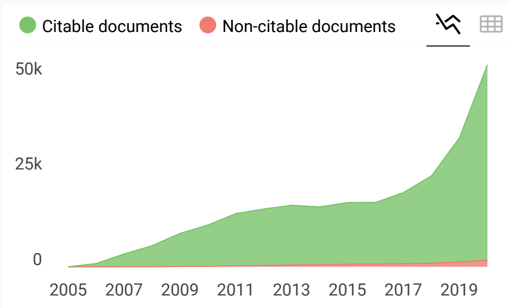

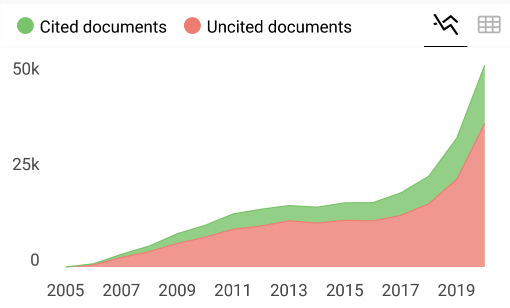

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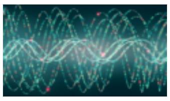

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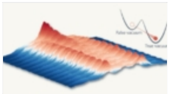

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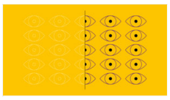

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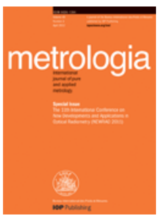

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PREFACE

Dear distinguished Authors and Guests,

The organizing committee warmly welcome you to The 2nd UPY International Conference on Applied Science and Education (UPINCASE), held on 3 – 4 November 2020 in Yogyakarta, Indonesia virtually. UPINCASE 2020 is implemented virtually, because as we all know, it is currently still in the state of the Covid-19 pandemic, so this limits our space. The topics covered in this conference include Engineering, Information Technology, Technology for Education, Applied Science, and Science Education.

On behalf of The 2nd UPINCASE 2020, we would like to thank all the authors that contributed to this conference. We would like to extend our special gratitude to the Keynote Speakers who support this conference.

1) Prof. Tai-Chien Kao (National Dong Hwa University, Taiwan)
   Theme: Science and Technology for Future Education
2) Prof. Wasino (Universitas Negeri Semarang, Indonesia)
   Theme: Social Transformation in Society 5.0
3) Dr. David Nwanna Dumbiri (University of Benin, Nigeria)
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4) Prof. Suzuki Takashi (Kobe University, Japan)
   Theme: Business and Services Transformation in Society 5.0
5) Dr. Arman Shah bin Abdullah (Universiti Pendidikan Sultan Idris, Malysia)
   Theme: Innovation of Educational Technology
6) Dr. Paiman (Universitas PGRI Yogyakarta, Indonesia)
   Theme: Technology Development to Increase Crop Production

The conference was held for two days and divided into two parts, Plenary Session and Parallel Session. On the first day, the keynote speaker at the Plenary Session is Prof. Kao (Taiwan), Prof. Wasino (Indonesia) and Dr. Dumbiri (Nigeria), then continued with Parallel Session. On the second day, the keynote speaker at the Plenary Session is Prof. Takashi (Japan), Dr. Arman Shah (Malaysia) and Dr. Paiman (Indonesia), then continued with Parallel Session.

The conference was held online through the Zoom Meeting, and was attended by around 250 participants on the first and second day. The technical problem at this conference was about the unequal conditions of the internet network in each participant's area, so that it was a bit of a hindrance, especially during the Parallel Session.

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The number of papers presented at this conference was 172 papers, which was divided into 9 Virtual Room, in two days. After the peer review process, the submitted papers were selected on the basis of originality, significance and clarity for the purpose of the conference. We hope that the conference results constituted significant contribution to the knowledge in these up to date scientific field.

We will be committed ourselves to make this conference more and more professional with fully and enjoyable academic research and discussion platform for authors and attendees. Sincerely as always, we look forward to your attention and support to the next UPINCASE.

With our warmest regards,
Marti Widya Sari

Conference Chair
5 November 2020
Universitas PGRI Yogyakarta, Indonesia

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RDBMS dan Google Maps Integration Model for WebGIS Based Land Ownerships Data Visualization

To cite this article: E Sutanta *et al* 2021 *J. Phys.: Conf. Ser.* **1823** 012031

RDBMS dan Google Maps Integration Model for WebGIS Based Land Ownerships Data Visualization

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Abstract. Map-based visualization of land ownership data is much needed by policymakers, both in government and private institutions. The utilization of this data is primarily to support macro planning, policy-making, and good governance. On the other hand, there are currently many application systems available which are the RDBMS database. This research examines the proposed RDBMS integration model and Google Maps maps to visualize land ownership data in a dynamic map view. The prototyping method is applied in this study to show how the available RDBMS can be improved to visualize land ownership data in a WebGIS-based application. The proposed model is tested using an application prototype. Technically the model can be implemented without significant constraints, but the actual implementation still faces obstacles, especially related to policies related to the cross-sectoral utilization of population databases and the obligation to maintain data confidentiality.

1. Introduction

Map-based visualization of land ownership data is much needed by policymakers, both in government and private institutions. In government agencies, the use of data visualization is primarily to support macro planning, policy-making, and good governance. Map-based visualization of land ownership data is generally provided through a Geographic Information System (GIS) based application, both displayed offline and online via a website (WebGIS) or mobile GIS.

In Indonesia, there are at least 3 parties with an interest in land ownership data. The first is the landowner, namely Indonesian Citizens (WNI) who own the land, the second is the authorized government agency and the third is the public with an interest in land ownership information. For landowners, ownership of land assets is proven by ownership of land certificate documents. The problem on this site is that there are still many land areas in Indonesia that are not registered or have not been equipped with land certificate documents [1]. As a result, there are frequent cases of land claims by other parties because the original owners did not have documentary proof of land ownership. The next party, namely the government agency authorized in this case is the Ministry of Agrarian Affairs and Spatial Planning / National Land Agency (Ministry of ATR / BPN), which is the party responsible for land ownership management services, land ownership data management, and the provision of land information. The Information and Documentation Management Officer (IDMO) at the Ministry of ATR / BPN is in charge of providing services, provision, storage, documentation, and security of public information within the Ministry of ATR / BPN The types of public information provided by IDMO are grouped into two groups: first is *Announcement*, which is information that must be published to the public and second is *Application*, which is information that will be provided upon request, including Periodic Information, Information Available at Any Time, and Information as well as Merta[2]. In some cases, requests for land information can be rejected by the PPID because they are included in the excluded or unavailable categories [1]. Public land information can also be provided in a graphic display, for example, a Detailed Spatial Plan (DSP) on the site https://gistaru.atrbpn.go.id/rdtrinteraktif/. Finally, the public with an interest in land ownership information is residents or communities who need this information for various purposes.

In summary, problems related to providing information on land ownership in Indonesia can be identified and described into two types. The first problem is, on the one hand, data on land ownership is very important data that must be safeguarded for security and confidentiality, so that only certain data that is truly safe and open can be displayed to the public, on the other hand, a new paradigm in the Land Information System. (LIS) in Indonesia is aimed at a system that must play a role in spatial based decision making to realize sustainable development through one map policy. Many attempts have been made by the Government and the private sector to integrate LIS with the National Spatial Data Infrastructure (NSDI) so that spatial information can be easily accessed by interested parties. However, new efforts are still needed because they do not fully meet the needs of users. Several things that become obstacles to the integration of DSP and NSDI are related to problems in institutional aspects, policy regulations, standards, data, human resources, and network access [3].

The second problem, along with population growth and a shift to industrialized countries, has led to increasingly strategic and complex agrarian, spatial, and land management in Indonesia. The policy of combining land register and land use raises a potential problem that spatial planning and land management efforts require the availability of basic data and accurate and detailed information. Thus, accurate and detailed basic data is very important for land administration in the activities of land registration, determining firm and accurate boundaries, identifying state land, and granting legal status to land [4].

Regarding the provision of land information, the Ministry of ATR / BPN continues to innovate, including developing several application systems. An example of an application system being developed is *"Sentuh Tanahku"* which can be downloaded for free and is available in Android or iOS versions. This application has several features, including information on service lists, progress in file management, and location of land parcels[2]. Digital service applications have also been developed, one of which is *Hak Tanggungan Elektronik (HT-el)*. Another innovation is the development of a mobile application for collecting land data by name *Survey Tanahku*. Another application is *Sistem Informasi Pemetaan Tematik (SiPeTik)* which was developed based on mobile GIS. This application functions as a spatial and textual data collector related to thematic geospatial information on land parcels and areas for Fit-for Purpose which integrates thematic map data and information in web services and displays survey results in real-time through Thematic Geoportal [5].

As stated earlier, there are three parties involved with land ownership data, namely landowners, government agencies, and the public. The landowner in this case is an Indonesian citizen (WNI) whose complete identity is already available in the national population database. Thus, the use of this national population database can be improved, including for visualizing land ownership data. There are at least 3 references that are close to this topic, namely the design and implementation of a database for web GIS-based rice diseases and pests system. [6], WebGIS for asset management of land and building of Madiun city government [7], dan the design of relational database for multipurpose WebGIS applications [8]. Others, several systems development efforts that combine attribute data and spatial data into WebGIS applications have also been carried out. Some of them can be found on [9], [10], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], And many others.

The description above shows that the WebGIS application continues to grow rapidly, important, much needed and can be applied to all aspects that require visualization of attribute data and spatial data. WebGIS applications need to be managed properly so that they are easy to use, data accuracy and security are maintained, and must be able to support the needs of users according to their authority.

Based on the references mentioned, it also appears that attribute data and spatial data in WebGIS applications are generally sourced from relational database models (RDBMS).

This paper reviews the proposed RDBMS and Google Maps service, integration model. The model presented is the preliminary result of research on the integrated use of Indonesia's national population database to various other systems. The model built serves to visualize attribute data and spatial data related to land ownership. Data visualization is a dynamic map display based on WebGIS. The WebGIS application was chosen in this study for 2 main reasons. The first reason is that users do not need special software to be able to access information on the WebGIS application, which is simply by using an internet browser that can be accessed via a desktop. The second reason, users can search for geographic data information that suits their needs by simply selecting the data filter option.

2. Materials and Method

The relational database model that will be integrated into this study uses the database design in Sutanta et al (2019) [8], which is then expanded to include a national population database that can be used for various applications [25]. The population database integration model is carried out using a single and centralized master database scenario [26]. A prototype is developed to test the proposed model. The prototyping approach is used because the user has defined the general purpose of the WebGIS application but does not identify specifically the system's input, processing, or output requirements. The sample data for model testing is using data on population land ownership in Sleman Regency, Yogyakarta Special Region.

The model developed in this study uses a prototyping approach based on Robert S Pressman [27] and Ian Sommerville [28]. Prototypes are built in stages, including requirements gathering and analysis, quick design, build a prototype, initial user evaluation, refining prototypes, and product implementation and maintenance. For each stage, experiments were carried out to see whether the prototype that was built was working as expected. In the first stage, the requirements of the system are defined. During the process, we interviewed the users of the system to know what is their expectation from the system. The second phase is a preliminary quick design. In this stage, we designed a simple design of the system using a Data Flow Diagram (DFD). It gives a brief idea of the system to the user. However, it is not a complete design. In the build a prototype phase, we designed an actual prototype based on the information gathered from quick design. We use several software tools at this stage. The back-end apps are built using Android Studio tools, SQLite / Firebase, Google Maps API, and GPS / Location-Based Service. Web apps are built using the Web Application Framework (Bootstrap) tools, Web API, PHP, HTML, XML, Javascript, Google Maps API, MySQL, and PostGIS. Mobile apps are built using Android Studio tools, Google Maps API, GeoServer, and WMS (Web Map Service). Google Maps is used as a base map. Determination of latitude and longitude points is done through a survey on the location of the land with the help of a GPS device. GPS devices are used to capture latitude and longitude coordinate data at each corner point on land objects which will be entered into the database and displayed on the map. In the initial user evaluation stage, we presented our proposed model to the user for an initial evaluation. It helps to find out the strength and weaknesses of the working model. Comment and suggestions are collected from the user and provided to the developer. Next is the refining prototype stage. In this stage, we need to refine the prototype according to the user's feedback and suggestions if the user is not happy with the current prototype. This phase will not over until all the requirements specified by the user are met. Then, a final system is developed based on the approved final prototype, once the user is satisfied with the developed prototype. The last stage is to implement products and maintain them. Once the final system is developed based on the final prototype, it is thoroughly tested and deployed to production. We have conducted prototype testing on two things, namely component testing (including unit testing and module testing) and integration testing (sub-system testing and system testing). We will still carry out acceptance testing on the prototype model built.

3. Proposed Model

Our proposed model utilizes a national population database as a data source for users who require identity authentication. System users involved include Land Owners who are included as a registered user group, authorized government agencies including Super Admin, Region Admin, Surveyor, and Public Users (Guests). Super Admin is the designated personnel and has the authority to administer the system and manage user and regional master data. Region Admin is a person who is appointed and has the authority to manage data on land ownership in his working area. Surveyors are personnel who are appointed and have the authority to conduct surveys and send data related to the location of land objects. In our model, Public Users are guest users on the system who do not need to be anonymous. They can access the application freely without the need to log in first. Figure 1 represents the basic components and workflow for our proposed model.

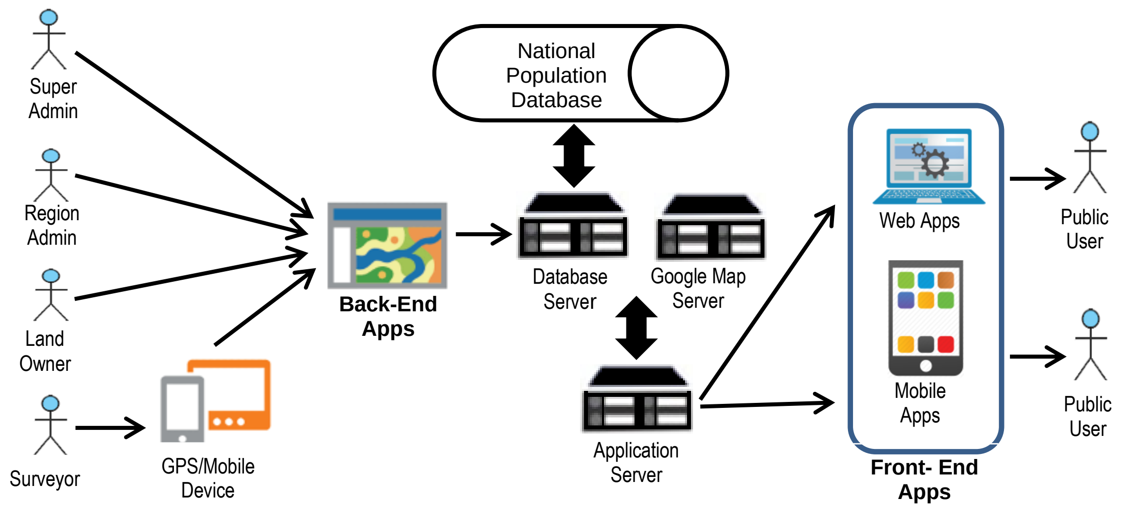

Figure 1. Basic components and workflow of WebGIS-based of land ownership data visualization

3.1. Functionally Requirement

The functional requirements of the proposed model include:

1. The model can request population identity data in the national population database.
2. The model can be set to be used in all regions in Indonesia.
3. The model can manage master user data, region.
4. The model can manage the land ownership data of each owner.
5. The model can receive input land location coordinate data from the GPS device.
6. The model can display user information, area, land ownership, and land location.
7. The Model can display detailed and summary geographic information in text, table, and graphic formats.

3.2. Model Scenario

Referring to Figure 1, the national population database is used as a source of identity data for Super Admins, Region Admins, Land Owners, and Surveyors. The identity of each user is identified based on the value in the identity identification number (NIK) attribute. Based on the NIK value, the identity data is then identified in the national population database. Thus, the database in the model that was built no longer needs to record the full identities of the users. Furthermore, the scenario in the proposed model is designed as follows:

1. Super Admin has the right to manage master data on the identity of residents, users (level, group, Region Admin), and regions, as well as managing data where the system is implemented. Super Admin consists of only 1 person who is fully responsible for the operation of the system. To

access the back-end page, the Super Admin must log in based on the username and password registered to the system.
2. Region Admin has the right to verify Surveyor data, land ownership, and land location in the territory under its authority. To access the back-end page, the Region Admin must log in based on the username and password that has been registered in the system. Region Admin can consist of many people. To become a Region Admin, a person must register himself in the system and meet the predetermined criteria.
3. Surveyor has the right to enter latitude and longitude coordinate points for each land boundary corner point for each land ownership. To access the back-end page, the surveyor must log in based on the username and password registered to the system. The surveyor can consist of many people. To become a Surveyor, a person must register himself in the system and meet the predetermined criteria. The coordinate data for each plot of land that has been verified by the Region Admin will be displayed on the map and given a symbol according to the coordinate point.
4. Landowners have the right to access detailed information about their land. To access the back-end page, the landowner must log in based on the username and password registered in the system. Landowners can consist of many people. Landowners can view detailed data on their land by clicking on the symbol on the map so that a popover appears containing complete information on the plot of land they own.
5. Public users can only see basic information published on the front-end page. He only needs to click on the symbol on the map, so that a popover appears containing information regarding the selected plot of land.
6. Report modules are equipped with search filters, such as date, region, status, etc..
7. Report modules are equipped with print processing options and export data to MS Excel format.
8. Users can display information or reports according to the desired criteria by utilizing search filters.

To support this scenario, a user interface (UI) was developed on two sides, namely the back-end and front-end. The back-end UI is a page that is used to control, input, edit, and delete data according to the authority of each registered user. The front-end UI is a page created for use by public users.

3.3. The Model Architecture
According to Figure 1, the proposed model architecture is composed of two parts, namely back-end apps and front-end apps. The back-end apps are built using Android Studio tools, SQLite / Firebase, Google Maps API, and GPS / Location-Based Service. The front-end apps consist of 2 parts, namely the web application and the mobile application. A web application (or web app) is an application software that runs on a web server, unlike computer-based software programs that are stored locally on the Operating System (OS) of the device. Web applications are accessed by the user through a web browser with an active internet connection. These applications are programmed using a client-server modeled structure. The user ("client") is provided services through an off-site server that is hosted by a third-party. Web apps are built using the Web Application Framework (Bootstrap) tools, Web API, PHP, HTML, XML, Javascript, Google Maps API, MySQL, and PostGIS. Mobile apps are built using Android Studio tools, Google Maps API, GeoServer, and WMS (Web Map Service).

4. Result and Discussion
We have built a prototype for the RDBMS integration model and Google Maps for WebGIS based land ownership data visualization. Integration is demonstrated by the use of the national population database in the prototype. Next, we conducted tests to evaluate the model using a prototype that was operated online. In testing, we use a dummy version of the national population database, because getting this database is not easy. It needs a licensing process that is relatively long and goes through the bureaucracy that is not easy. This test is carried out on 19 scenarios on the model compared to the output produced by the prototype. In summary, the results are shown in Table 1.

Table 1. Actual result for eight test case scenario

Test Case	Scenario	Expected Result	Actual Result
Super Admin	1. Super Admin must log in to access the back-end page	If login is successful, the Super Admin UI appears, if that fails, an error message appears	Success
	2. Super Admin has the right to manage master data on the identity of the population, the user (level, group, Region Admin), and region, as well as manage the data where the system is implemented	If the login is successful, Super Admin can manage the resident identity master data	Success
		If login is successful Super Admin can manage master user data (level, group, Region Admin)	Success
		If Login is successful Super Admin can manage region master data	Success
		If Login is successful Super Admin can set the region for system deployment	Success
	3. Super Admin is only one person and is fully responsible for the operation of the system throughout Indonesia	There is only one user name and password for Super Admin	Success
Region Admin	4. Region Admin must log in to access the back-end page	If the login is successful, the Super Admin UI appears, if that fails, an error message appears	Success
	5. Region Admin has the right to verify Surveyor data, land ownership, and land location in the territory under its authority	If the login is successful the Region Admin can verify the Surveyor data	Success
		If the login is successful the Region Admin can verify land ownership data	Success
		If the login is successful the Region Admin can verify the land location data	Success
	6. Region Admin can consist of many people	If the registration is complete, the Region Admin data can be stored in the database	Success
	7. To become a Region Admin a person must register himself in the system and have met the predetermined criteria	If the registration form is complete, the Region Admin has been successfully added	Success
Surveyor	8. The surveyor must log in to access the back-end page	If the login is successful, the Super Admin UI appears, if that fails, an error message appears	Success
	9. Surveyor has the right to enter latitude and longitude coordinate points for each land boundary corner point for each land ownership	Data of latitude and longitude coordinates are successfully sent using GPS and stored in the database	Success
	10. Surveyor can consist of many people	If the complete Surveyor registration form is successfully added	Success
	11. To become a Surveyor a person must register himself in the system and meet the predetermined criteria	If the complete Surveyor registration form is successfully added	Success
	12. Every area of land that has been verified will be displayed on the map and given a symbol according to its coordinate point	Land area appear in WebGIS according to the latitude and longitude coordinates	Success
Owner	13. The owner must log in to access the back-end page	If the login is successful, the Owner UI appears, if that fails, an error message will appear	Success
	14. The owner has the right to access detailed information about his land	The owner can display detailed information on his land	Success
	15. The owner can consist of many people	If the registration form is complete, the Owner has been successfully added	Success
	16. Each Owner can view his / her land details in map view	The owner can display detailed information of his land on the map	Success
User Public (Quest)	17. The quest can only see basic information published on the front-end page	The quest cannot see detailed land ownership information on the front-end page	Success
	18. Report modules are equipped with search filters, such as date, region, status, etc.	Information filter works	Success
	19. Report modules have the option of printing and exporting data to MS Excel format	Print option works	Success
		Export options work	Success

We also made comparisons between our model and previous studies [6, 7, 9-23]. In general, it can be seen that the WebGIS application is an implementation of the Location-Based Service (LBS) method. WebGIS displays integrated spatial data and attributes data, information is displayed online via the website, utilizes the Google Map service via the Google Map API, the information object displayed can be anything, the location of the object can be anywhere, partly to display spatial data and attribute data integrated, some applications are limited to being used to display information and some others to support the management process, and are generally specific to certain areas and/or objects because they are developed partially. The advantage of the model we are proposing is that it is integrated with a national population database that functions as master data for the identities of users. Thus, data consistency will be maintained, especially on identity and territorial data. Our model can also be applied to other areas in Indonesia because there is a regional codification for all parts of Indonesia. During the test, there were no problems in the display, both WebGIS and mobile GIS. The proposed WebGIS model can be applied to all provincial districts/cities in Indonesia because the regional master data is already stored in the database.

However, the proposed model still needs to be refined. First, the owner data recorded in the land certificate document may not be the name of the real owner. This occurs because the process of transferring land ownership is often not immediately followed by changes to land certificate documents. Second, until now there are still many land parcels in Indonesia that have not been registered or have not been completed with land certificate documents [5]. The scenario in the proposed model only records and displays land ownership data that is equipped with land certificate documents. This scenario has the advantage of being able to easily reveal land areas that are not yet certified, but on the other hand, it can lead to conflict. The uncertified land looks like it is no man's land, even though there may be someone who owns it, but the land certificate documents have not been processed. The amount of landowner data also needs special attention to the use of user names and passwords. Besides, some landowners, especially those who live in remote areas, are unfamiliar with the use of Information Technology. Given that land is a very valuable asset, it is also necessary to pay attention to how to keep the system completely safe from illegal access or potential system failure. Testing the proposed model still uses dummy data, so it is necessary to test using real data.

The results of this study support the concept which states that prototype is an initial version of a software system that is used to demonstrate model, try out design options, and find out more about the problem and its possible solutions [28]. Rapid, iterative development of the prototype is essential so that costs are controlled and system stakeholders can experiment with the prototype early in the software process [28].

5. Conclusion

An integration model for RDBMS and Google Maps services was developed and tested using a prototype run online. The results of model testing, almost all functions can run according to the designed scenario. The strength of the proposed model is the consistency of identity and territorial data. The model developed allows it to be applied to other regions in Indonesia without the need to change the database or application. Even so, further research is still needed to overcome non-technical problems, including inconsistencies in owner data recorded in land certificate documents that may not be the actual owners, there are still many land parcels in Indonesia that have not been equipped with land certificate documents so that it seems if it is no man's land, testing is required using the real national population database so that the response time is known and a data security mechanism can be designed.

6. Acknowledgement

The authors would like to thanks the Institut Sains & Teknologi AKPRIND Yogyakarta Indonesia that was supported for this research and the Ministry of Research and Technology / National Research and Innovation Agency (Kemenristek/BRIN) of the Republic of Indonesia that was supported for this publication through the Fundamental Research Grant with a reference letter No. number: B/87/E3/RA.00/2020.

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