



Design of a Village Letter C Information System Based on a Website Using Apps Script

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Abstract: In terms of data management administration, recording land ownership documents such as Letter C is one of the areas that uses information systems in the village in its implementation, but many villages still rely on manual recording methods, causing operational inefficiencies and minimizing the risk of data loss. With the need for a less complicated process, the purpose of this study is to create and develop a web-based Letter C information system application using Google Apps Script that is digital and integrated to simplify land ownership management and data. One of the development-oriented approaches used is Prototyping. Able to create a working model of the system in its most primitive form and to get initial feedback from users. This allows the system to develop iteratively driven by user needs and preferences. This leads to a system that can record, search, and update land ownership data dynamically. The results of the study show that the proposed Letter C data management system greatly improves the efficiency of Letter C data management while reducing the risk of data loss or making errors. The implication of implementing this system is the increased ability of the village government to provide structured, transparent, and accountable land ownership administration services. This in turn can enable a more accurate and data-based decision-making process in the management of village land assets. Thus, this research can be part of the efforts to digitize the village governance system in the early period, especially in land data management.

Keywords: Information System; Letter C; Apps Script; Prototyping; Land Digitization.

1. Introduction

Land is a valuable asset with high economic and social value. Population growth that continues to increase every year is not comparable to the increase in land area, thus driving demand for land ownership and management. One of the main challenges faced by villages, including Tunjungan Village in Purworejo, is the manual recording of Letter C documents. Letter C is an important document that records land ownership, but its unorganized management often causes various problems such as recording errors, difficulty in accessing information, and potential agrarian conflicts. Tunjungan Village, located in Ngombol District, Purworejo Regency, Central Java, still relies on traditional methods to record land ownership through Letter C documents. These documents include girik, kikitir, and Petok D, which are not officially recognized by the state as valid proof of ownership. This situation exacerbates the potential for agrarian conflicts because unclear ownership status is often a source of land disputes, including in Purworejo. Many villagers have not upgraded their land status to a Certificate of Ownership, which causes high legal uncertainty regarding land ownership. This uncertainty not only hinders local economic development but also creates distrust in the land administration system.

In addition to ownership issues, the lack of an integrated system also complicates the payment of land and building tax (PBB). Inaccurate data or difficulty in accessing information causes delays in tax payments, which ultimately affect village income and administrative processes. In this context, an appropriate information system is needed to facilitate the digitization and management of more efficient and structured Letter C records. This system is expected to be a solution to improve data accuracy, facilitate access to information, and accelerate land-related administrative processes at the village level. Several previous studies support the importance of a digital land management system. Botutihe *et al.* (2022), in their study emphasizing the importance of digitizing land information systems, stated that digitizing land information systems is a must for modern society to create good and transparent governance [1]. This finding underlines that the adoption of information technology in land management is no longer an option, but rather an urgent need to improve efficiency and accountability. Furthermore, Soepandi and Hari (2021), through their research on the design of a web-based village book C information system, showed that the system improves service efficiency at the village office by providing more accurate and easily accessible land information [2]. This study proves that an integrated information system can significantly reduce the time and costs required in the land administration process.

Amanita and Septiansyah (2020) highlighted the problem of land management in Cimahi and noted that the PTSL (Complete Systematic Land Registration) program offers a solution for land administration, although there are still shortcomings, such as the lack of land block records [3]. This shows that despite government initiatives to improve land administration, there are still gaps that need to be addressed, especially in terms of data detail and accuracy. Meanwhile, Nugraha *et al.* (2021) discussed a land use information system based on land parcels, which can facilitate data analysis and monitor land use changes in Sukoharjo [4]. This study highlights the importance of utilizing technology to monitor land use changes, which can assist in spatial planning and sustainable development. Setiawan *et al.* (2022) emphasize the importance of managing village Letter C archives to preserve land history. They emphasize that Letter C is a vital document that requires extra protection due to the risk of data damage or loss [5]. This study emphasizes that Letter C documents are not only administrative records, but also an important part of village history and heritage that needs to be protected. Finally, Laila (2023), in her research on the ease of access to evidence of land ownership based on Letter C, highlighted the challenges faced by village governments in presenting this public information easily, especially related to administrative disorganization [6]. This shows that the main challenges in managing Letter C are not only technical issues, but also organizational issues and accessibility of information.

Based on the various problems that have been described, ranging from unorganized manual recording, difficulties in accessing information, to the potential for agrarian conflict due to unclear land ownership status, a comprehensive and integrated solution is needed. This study aims to design and implement a web-based information system using Google Apps Script to digitize the recording of Letter C documents in Tunjungan Village. This system is expected to overcome various obstacles related to land data management and access, as well as support more efficient and accurate administration processes, including PBB payments. Using the prototyping method, this system was developed iteratively, allowing adjustments based on user feedback, thus ensuring that the system better meets the needs of village communities and minimizes errors in land data management. Thus, this study is expected to provide a significant contribution to efforts to modernize land administration at the village level.

2. Research Method

According to Pressman, prototyping is an activity that can be used to support any development approach and help users and developers better understand the needs of the proposed system [7]. This research utilizes the prototyping method in the development of the information system, which was chosen because it allows for the creation of an initial model that can be directly tested by users, accelerating evaluation and improvement. The prototyping method is an approach in software development where an initial model of the system, or prototype, is quickly created to provide an early indication of how the desired system will function. This prototype is then tested and evaluated by users to obtain feedback, which is subsequently used to refine the system. This method enables developers and users to collaborate intensively throughout the system development process.

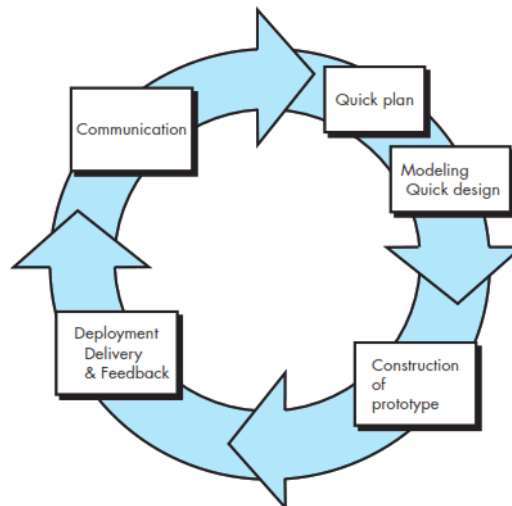


Figure 1. Prototyping Method

The prototyping approach is implemented through a series of structured, iterative, and user-focused stages. Each stage is designed to ensure that the information system developed is not only technically functional, but also relevant, easy to use, and meets the specific needs of the Tunjungan Village. These stages are not a rigid linear process, but rather a repetitive cycle, where feedback from one stage will be input to the next stage, resulting in a system that continues to develop and be refined. The following is an in-depth explanation of each stage:

2.1 Communication

In the initial stage, the system requirements are identified by gathering information from village officials and the community regarding the recording of Letter C. The needs assessment is conducted through interviews and field observations to understand the existing problems. Observations and interviews were conducted at the Tunjungan Village Hall on March 8, 2024, attended by Mr. Suyono, the Head of the Village, and Mrs. Nurhayati, the Village Secretary. From this interview, an in-depth understanding of the issues faced in managing Letter C was obtained, including limited data access and the risk of document loss. The process of recording land ownership observed is still done manually, using ledgers and paper archives. Although this traditional method has been in place for a long time, village officials recognize several challenges, such as the slow process of searching archives and the vulnerability to damage or loss of documents, all of which hinder efficient land data management. The interview results also revealed the village officials' desire for a more modern and integrated information system to facilitate fast and accurate data recording and retrieval.

2.2 Quick Plan

Based on the observations and interviews conducted on March 8, 2024, in Tunjungan Village, strategic steps have been formulated for the development of a digital information system. This system aims to facilitate the recording of land ownership documents, effectively replacing the traditional recording methods currently in use. By implementing this new system, the goal is to improve both efficiency and accuracy in data management. The digital information system will be equipped with several important features. The Homepage will display statistics on landowners and payment history, providing users with an overview of relevant data.

The Owner Page will contain complete information about landowners, including their Letter C numbers, while the Land Ownership Page will offer detailed information regarding ownership status, area, and type of land. Additionally, the Tax Payment History feature will provide proof of tax payments based on the Tax Object Number. To ensure the successful development of the system, various technologies will be utilized. Google Apps Script will automate data management and facilitate integration with Google Sheets, which will serve as the primary database for land and tax payment data. Google Drive will be used to store digital documents such as Letter C, while HTML/CSS and Bootstrap will help in building a responsive interface. Furthermore, Google Sites will provide online access without the need for additional server infrastructure, and Google Authentication will ensure data security for authorized users. The expected functionalities of the system include the ability to add, edit, and delete landowner data, along with features for data search and filtering to allow quick access to information. Users will also have the capability to download data for recap purposes and manage digital documents related to tax payment evidence. The non-functional requirements for the system encompass strict data security, online access with minimal downtime, high responsiveness, and fast loading times. The interface will be designed to be intuitive, catering to users with limited technological backgrounds, ensuring ease of use for all stakeholders involved.

2.3 Modeling Quick Design

The rapid design modeling stage is the process of designing the system based on the initial planning that has been outlined. In this stage, developers create an initial prototype before coding begins. This design needs to be adjusted to user requirements to provide a clear picture of how the system will work and look. The goal is to enable users to provide feedback before the coding phase starts. The system design will be illustrated through case diagrams, activity diagrams, database design, and prototypes. A use case is an important tool in system development that describes user interactions with the application. Each use case outlines the steps of specific tasks, including the required inputs, system processes, and expected outputs. The presence of use cases facilitates communication between developers and stakeholders and helps formulate the functional requirements of the system. In this study, there is one main actor, the Village Secretary, who interacts with the system. Use cases include activities such as accessing land ownership statistics, managing owner data, updating ownership status, and managing tax documentation. Thus, the use case diagram provides a clear understanding of the interaction between the actor and the system to achieve the desired objectives.

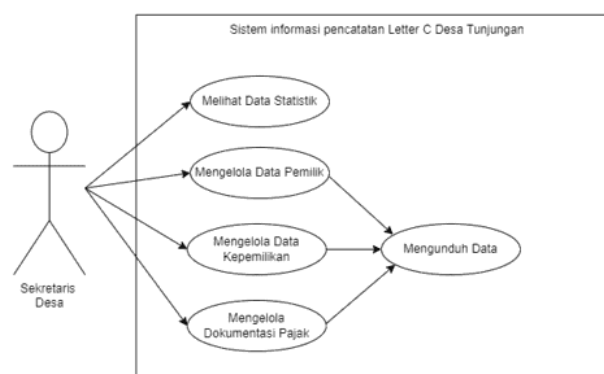


Figure 2. Use Case Diagram

An activity diagram is a visual tool used to depict the workflow or process within a system. This diagram illustrates the various activities involved in a process, as well as the sequence and conditions connecting these activities. By presenting the steps and decisions that need to be made, the activity diagram facilitates understanding of how the system operates. Therefore, the activity diagram can provide information about the execution of a specific activity within the system. The activity diagram for managing owner data is displayed in Figure 3.

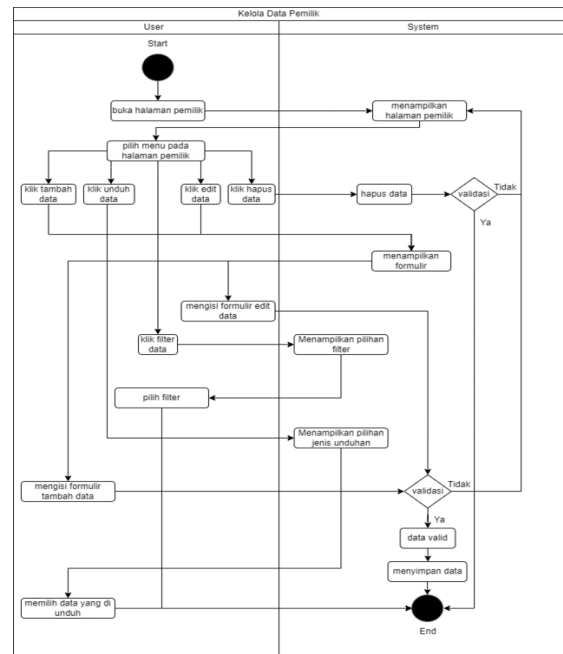


Figure 3. Activity Diagram for Managing Owner Data

In this study, Apps Script is used as the backend for data management and automation. Google Sheets was chosen as the database due to its ease of integration with Apps Script, as well as its capability to store, process, and visualize data in real-time. Furthermore, Google Sheets provides easy access for users and flexibility in data management. The database design can be seen in Figure 4.

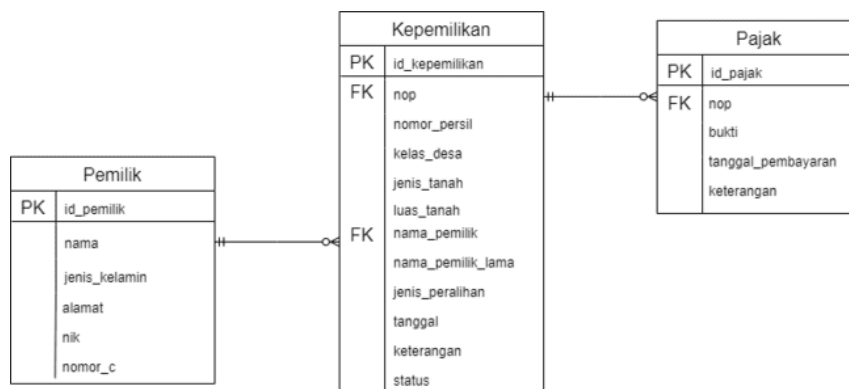


Figure 4. Database Design

By using Google Sheets as the database, this system can operate more efficiently without the need for complex server infrastructure. This makes it an ideal solution for environments requiring web-based data management. In this system, there are three tables, which can be seen in Figures 5 to 7.

The screenshot shows the Microsoft Excel ribbon with the 'Formulas' tab selected. The ribbon includes the following groups and options:

- Formulas**: AutoSum, Calculation Options, Sum, Average, Count, Max, Min, Product, StDev, StdDev, Variance, StdDev, Percentile, Rank, and Array.
- Calculation Options**: This group is highlighted, showing options for 'Show Formulas', 'Show Results', and 'Show Formulas and Results'.
- Formulas**: This group contains various mathematical functions such as Sum, Average, Count, Max, Min, Product, StDev, StdDev, Variance, StdDev, Percentile, Rank, and Array.

Figure 5. Owner Table

[illegible]

Figure 6. Ownership Table

Figure 7. Tax Table

After the system design phase is completed, the implementation process is carried out to produce features that can be utilized. The resulting system interface can be seen on the designed pages, below is an example of the owner page layout.

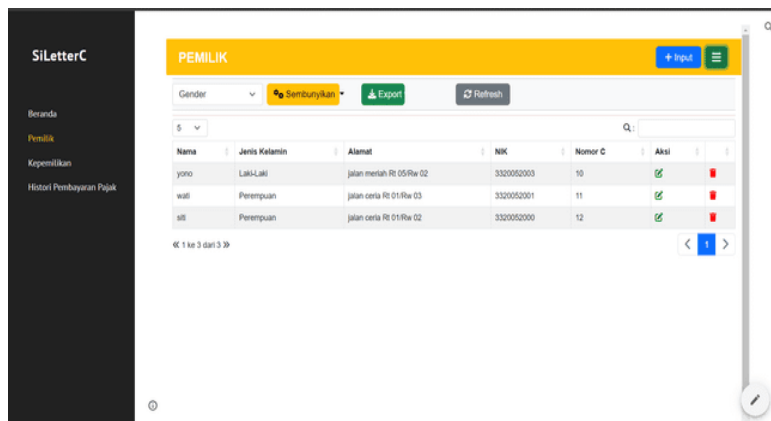


Figure 8. Example of the Owner Page

2.4 Construction of prototype

The prototyping development stage is a crucial step in translating the previously created design into programming code. During this phase, developers begin writing code based on the agreed-upon design, allowing the system to evolve into a functional application. This process includes coding, initial testing, and adjustments to the prototype according to feedback received, ensuring that the system operates according to user needs. Apps Script, a JavaScript-based scripting platform provided by Google, facilitates the automation of various tasks within Google Workspace. It allows developers to create simple web applications integrated with Google services such as Google Sheets, Google Forms, and Google Drive [8]. The system implementation process took place from June 30 to September 10, 2024, involving the use of programming languages such as JavaScript, HTML, and CSS. Additionally, Apps Script served as the text editor for writing code, while Google Sheets functioned as a relational database platform for data management.

2.5 Deployment, Delivery and Feedback

The deployment, delivery, and feedback stages represent the final steps in the prototyping method. Once the system has been successfully developed, functional testing is conducted by the users. During this phase, users evaluate the system being tested and provide feedback regarding its performance and reliability. User feedback is crucial, as it serves as an evaluation basis for making improvements and refinements to the system, ensuring that the final product meets the users' needs and expectations. The implemented system will be tested to ensure optimal performance. Testing is conducted using two approaches: black box testing and User Acceptance Testing (UAT). Black box testing aims to evaluate whether all system functionalities meet the specifications desired by the Tunjungan village authorities, without considering the underlying code. On the other hand, UAT focuses on direct validation from end-users to ensure that the developed system genuinely meets their operational requirements. This method entails testing based on the system's appearance and interactions, ensuring that each feature operates as expected by the users.

3. Result and Discussion

3.1 Results

The results of the design research for the Letter C information system in the village using Apps Script produced a system with four main menus. The first menu is the Homepage, which displays overall statistics of the stored data, including the number of landowners, total land ownership, status, as well as the area of both dry and wet land that is active. Additionally, there is a bar chart showing the tax payment history, providing a clear overview of the tax payment situation in the village.

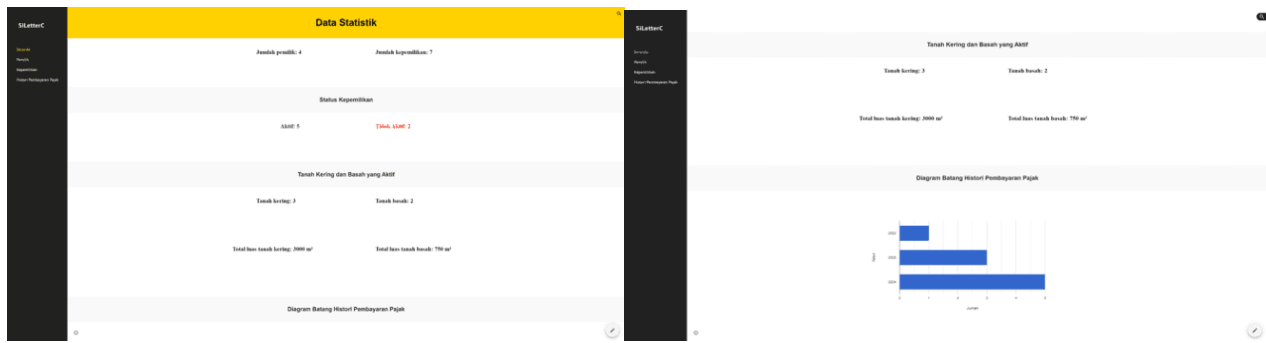


Figure 9. Homepage Display

The second menu, Owners, presents a table of information about the personal data of registered landowners in the village, facilitating the identification of owners. This menu includes features that assist in data grouping, such as filters to sort data based on the gender of the owners. Additionally, there is an option to print the data in formats like PDF and Excel.

Nama	Jenis Kelamin	Alamat	NIK	Nomor C	Aksi
dafta	Laki-Laki	Jalan Mekar 18 05/04/12	320202004	19	✓
yono	Laki-Laki	Jalan Mekar 18 05/04/12	320202003	19	✓
wati	Perempuan	Jalan Mekar 18 05/04/12	320202001	11	✓
isi	Perempuan	Jalan Mekar 18 05/04/12	320202002	12	✓

Figure 10. Owners Display

Figure 11. Owners Input Form

The third menu, Ownership, contains detailed information regarding land ownership, including the Tax Object Number, type of land, land area, and ownership status, which is crucial for data administration and management. Similar to the previous menu, it also features data grouping options and print functionality for easy output in various formats. The filters available on this page allow users to sort data based on several criteria: village class, type of land, type of transfer, ownership status, and the transfer date, which can be specified by both start and end dates. This enhances the user's ability to access specific information efficiently.

NCP	Nomor Perak	Kelas Desa	Jenis Tanah	Luas Tanah (m²)	Nama Pemilik	Nama Pemilik Lama	Aksi
3218030001200019	20	3	Kering	2000	dafta	yono	✓
3218030001200021	20a	3	Kering	1000	dafta	yono	✓
3218030001200020	20a	3	Kering	1000	dafta	yono	✓
3218030001200014	4	4	Basah	500	yono	isi	✓
3218030001200013	5	1	Basah	250	wati	isi	✓
3218030001200011	3	2	Kering	1000	wati	isi	✓
3218030001200012	3	2	Kering	1000	yono	wati	✓

Figure 12. Ownership Display

Figure 13. Ownership Input Form

The Tax Payment History menu stores documentation of Land and Building Tax payments, serving as a record of tax payment evidence. This menu provides filtering options based solely on the payment date, which can be specified by both start and end dates. Additionally, it includes a feature that allows users to easily access saved tax payment documentation by clicking a brown file icon in the "Bukti" column of the data table. This feature simplifies the retrieval of payment evidence, making it more convenient for users to manage and review tax records.

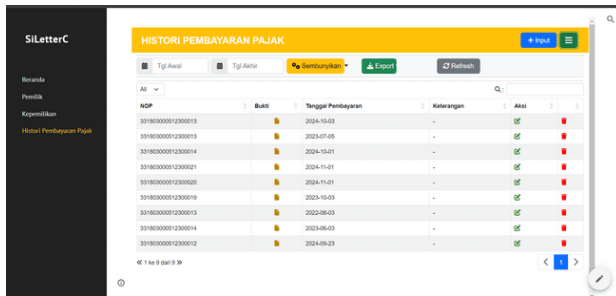


Figure 14. Tax Payment History Display

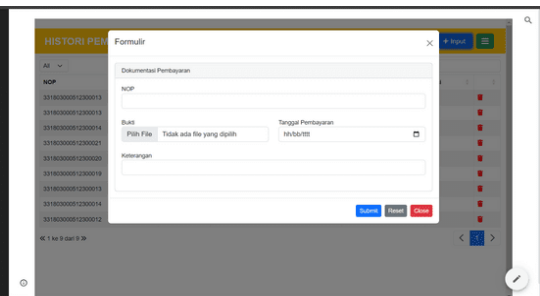


Figure 15. Tax Payment History Input Form



Figure 16. Display an Image of the Tax Payment Receipts in the tax Payment Documentation Data

After implementing the prototype as described above, system testing was conducted to ensure that the Letter C information system functions as expected and meets user requirements. Two testing methods were applied: black box testing and User Acceptance Testing (UAT). Black box testing is a software testing method that focuses on evaluating the system's functionality to determine whether it operates correctly. This testing method emphasizes the system's functionality without considering the internal structure of the code [9]. Black box testing concentrates on verifying that all features work properly according to specifications, without delving into the internal system details. The results of the black box testing can be seen in Table 1.

Table 1. System Testing Results Using Black Box

No	Test Feature	Test Description	Test Result
1.	Homepage	Display the number of owners	Successful
		Display the number of ownerships	Successful
		Display the status of active ownerships	Successful
		Display the status of inactive ownerships	Successful
		Display the number of active dry and wet lands	Successful
		Display the total area of active dry and wet lands	Successful
		Display a bar chart of tax documentation per year	Successful
2.	Owners	Fill out the registration form for owner data	Successful
		Reset the registration form for owner data	Successful
		Display the table of owner data	Successful
		Edit the owner data in the table	Successful
		Delete the owner data in the table	Successful
		Search for owner data in the table using the search box	Successful
		Filter the table by owner gender	Successful

		Hide or show table columns based on column names	Successful
		Download the owner data in the table as an Excel file	Successful
		Download the owner data in the table as a PDF file	Successful
		Copy the selected owner data from the table	Successful
3.	Ownership	Fill out the registration form for ownership data	Successful
		Reset the registration form for ownership data	Successful
		Display the table of ownership data	Successful
		Edit the ownership data in the table	Successful
		Delete the ownership data in the table	Successful
		Search for ownership data in the table using the search box	Successful
		Filter the table by land classification in ownership data	Successful
		Filter the table by land type in ownership data	Successful
		Filter the table by type of transition in ownership data	Successful
		Filter the table by ownership status in ownership data	Successful
		Filter the table by ownership transfer date by setting the start and end date filter	Successful
		Hide or show table columns based on column names	Successful
		Download the ownership data in the table as an Excel file	Successful
		Download the ownership data in the table as a PDF file	Successful
		Copy the selected ownership data from the table	Successful
4.	Tax Payment History	Fill out the registration form for tax payment history	Successful
		Reset the registration form for tax payment history	Successful
		Display the table of tax payment history data	Successful
		Edit the tax payment history data in the table	Successful
		Delete the tax payment history data in the table	Successful
		Search for tax payment history data in the table using the search box	Successful
		Open the image in the tax payment history table	Successful
		Filter the table by tax payment date by setting the start and end date filter	Successful
		Hide or show table columns based on column names	Successful
		Download the tax payment history data in the table as an Excel file	Successful
		Download the tax payment history data in the table as a PDF file	Successful
		Copy the selected tax payment history data from the table	Successful

User Acceptance Testing (UAT) is a testing method used to ensure that the developed system truly meets the needs and expectations of the users or clients [10]. At this stage, end users are directly involved in the testing process to confirm that the system is not only user-friendly but also aligns with their expectations. In this research, UAT was conducted with representatives from Desa Tunjungan, and the results indicated that the developed system significantly aids in land data management and enhances administrative efficiency in the village. This testing was also supported by a survey conducted using Google Forms, which was distributed to village representatives. The form contained several questions related to the impact of the system post-implementation, including ease of data access, improved processing speed, and significant changes perceived in land administration processes. The survey results demonstrated that the use of this system has a tangible positive impact on facilitating administrative tasks in the village.

3.2 Discussion

With the prototyping methodology, a web-based Letter C information system for Tunjungan Village has been successfully built, which provides great benefits to the village administration. This cycle allowed the research team to continuously develop and communicate with stakeholders from conception to implementation. Since many small iterations with shared design decisions and technical requirements occurred in this workshop, both parties were satisfied with the final prototype. Furthermore, the prototyping process was iterative and oriented towards obtaining rapid feedback, which played a significant role in reducing misunderstandings and ambiguities when we finally translated the prototype into actual programming code. The result—the system implementation—is a clear manifestation of the experimental prototype design agreed upon early in the process: A device built exactly as needed—proof that this strategy produces accurate results relatively quickly.

The developed system was thoroughly evaluated using a two-pronged approach involving black box testing and user acceptance testing (UAT). The system then underwent black box testing, which means testing the front-end of each user interface feature to ensure that for each input, the expected output is received without considering the internal code structure. The results of this testing phase were very positive, indicating that all tested components from data collection & input methods to information management & retrieval processes were accurate and reliable. This validated and ensured the robustness and stability of the core functionality of the system. In addition to the technical assessment, User Acceptance Testing (UAT) was conducted to measure satisfaction with the system and perceived usability from the perspective of end users, which in this case refers to representatives of Tunjungan Village. This was done through walkthroughs and feedback sessions as they used each feature created by the development team. The feedback received was positive, with village representatives reporting high levels of satisfaction with the ease of use, intuitiveness, and overall effectiveness of the information system in collecting, managing, and retrieving Letter C data. They particularly emphasized the potential of the system to improve access to information across communities through a web-based platform, which in turn promotes transparency and accountability in land administration.

While the core focus of the system was successfully covered, UAT also yielded some useful lessons for future iterations. More in-depth tools and areas within the system's features were suggested for improvement, to help move the system more efficiently in the right direction. Recommendations range from adding advanced search functionality, incorporating GIS mapping to visualizing land parcels spatially and creating reporting tools to generate customized reports. While not all these recommendations will be implemented immediately, they provide a framework and strategic direction for future iterations and improvements to the system, ensuring continued consistency and relevance for village governments and their residents. Examining the pilot process required to improve will drive the building blocks and applications of the system that will ultimately lead to features that will be implemented.

4. Related Work

The need for digital transformation in land administration (especially the implementation of web-based systems) continues to be an important theme in recent publications. These studies gather evidence of the potential of technology to simplify administrative processes, increase transparency, and improve access to important land information. Botutihe, Budisusanto, and Deviantari (2022) discuss the importance of land data digitization as an essential part of a comprehensive Land Information System in their paper on Prototype of Web-Based Land Administration Information System. It has been observed that such a system is essential to meet the needs of good governance in terms of making access to information transparent—not only to the

public but also to institutions that create value for the service [1]. This trust asset is consistent with the international agreement that modernizing public administration is entrusting public institutions with transparent land management in a digital system, which simulates public trust in the management of public affairs.

Likewise, Soepandi and Hari (2021) research on the Design of a Web-Based Land Book Information System C in Satriyan Village" produced similar findings that infrastructure resilience is positively correlated with service performance and efficiency. Their research shows that an efficiently designed web-based system can assist and increase confidence in reliable land data collection [2]. This emphasizes the urgency of not only digitizing information but also making it easily accessible, easy to use, and able to provide timely and accurate information. Infrastructure Focus: This is the practical aspect of running such a system in a village.

In addition, Amanita and Septiansyah (2020) research describes the advantages of utilizing a PTSL (Complete Systematic Land Registration)-based information system in handling various land management problems [3]. Unlike more general research, their research shows the advantages of using the system to simplify the land registration process, but also highlights one of its potential weaknesses, namely that it does not cover certain land blocks. This highlights the importance of a system that is tailored to local problems and needs. To overcome this limitation, Nugraha, Muryono, and Utami (2021) research discusses the capabilities of data analysis and real-time land use monitoring through an application they developed themselves [4]. They show that technology can not only facilitate land data management but also share knowledge for land use planning and monitoring.

In their research, Setiawan, Santi, and Budiman (2022) emphasized data security and confidentiality, especially for sensitive documents such as Letter C. Their research shows that Letter C documents play an important role in documenting land ownership history and must be protected from damage or loss [5]. This shows the importance of having solid security features in a digital land management system to protect the integrity and privacy of sensitive data. On the one hand, Laila (2023) mentioned that easy access to Letter C as a tool to validate land ownership while acknowledging the difficulties, which arise due to the implementation of unstructured administrative work in villages that hinder the socio-economic status of the community and complicate elements of society [6], so that not only data digitization but also administrative systems to enable transparency and ease of access to information.

This study introduces a web-based information system Letter C to facilitate handling, improve data accessibility, and optimize the management of land ownership documents. By utilizing the prototyping methodology, the results have answered the research objectives to create a customized solution that meets the specific and relevant needs in Tunjungan Village, which distinguishes it from other studies. This study also aims to offer iterative feedback and user involvement throughout the development process in contributing to land administration in the village by developing detailed reciprocal relationships to encourage efficiency, transparency, and accountability as well as understanding the importance of developing a digital land management system through a user-centered design approach and prototyping methodology.

5. Conclusion and Future Research

In this study, a web-based Letter C information system can be designed and built using Google Apps Script. This system provides benefits to simplify land data in Tunjungan Village, minimize agrarian conflicts, and facilitate land tax payments. Implementing a prototype allows researchers to achieve specific user-centered solutions through direct user feedback. The tested system was implemented in the village and successfully helped them improve information management and communication flows in their respective communities. This project has set a new benchmark for the development of village information systems and can be replicated and adapted in other villages facing similar challenges. The Letter C information system in Tunjungan Village shows that intentionally designed technology can empower local governance and encourage community participation. In the future, it can be further developed by integrating features with the National Land Agency to support the official land certification process. This not only improves existing infrastructure but also becomes a basis for future improvements because the system can be enhanced in the future by implementing additional security features, such as multifactor authentication and data encryption, to ensure the security of sensitive land ownership information. Partnering with other platforms such as the Village Information System will also expand the possibility of integration that makes this system more collaborative in managing village data.

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