Digital Transformation of Land and Building Tax Payments with Predictive Systems

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Abstract—*Digital transformation in the tax payment sector is an essential step to enhance transparency and accountability. This research aims to develop and implement a predictive information system that can predict the payment behavior of Land and Building Tax in Village. The main problem faced is the often slow and non-transparent payment process, as well as the risk of errors or payment defaults. The developed information system uses historical data analysis methods with predictive algorithms to project the future behavior of taxpayers. This system is also equipped with a real-time validation feature to improve accuracy and efficiency in managing payment data. The results show that the predictive information system can provide early warnings related to payment delays and reduce potential errors in recording Land and Building Tax payments. In conclusion, the application of predictive technology in the Land and Building Tax payment system in Village successfully improves transparency, accountability, and efficiency, providing an innovative solution for village tax administration issues.*

Keywords—Accountability, Predictive algorithms, Predictive information system, Digital transformation, Transparency

L. INTRODUCTION

Land and Building Tax is one of the main sources of income for the government, which is used to fund development programs and public services for the welfare of the community[1]. However, at the village level, land and building management faces various obstacles that hinder its effectiveness. The main challenges include low transparency, administrative inefficiency, and the potential for fraud that is detrimental to the community and the village government[2].

Land and building management is often hampered by manual recording that produces inaccurate data and the risk of misappropriation, late payments due to lack of reminders for taxpayers, and limited access to tax obligation information. This fragmented system not only reduces operational efficiency, but also complicates data analysis for strategic decision making. The risk of low compliance and difficulties in reporting and financial audits also weaken the accountability of village financial management. Therefore, it is necessary to develop an information system that can improve efficiency, transparency, and accountability in village land and building tax management[3][4].

Research [5] examines the optimization of land and building tax collection at the Tangerang City Regional Revenue Agency. They found that the efforts of the Tangerang City Bapenda have implemented various optimization efforts in land and building management, but are still lacking in terms of supervision through surprise inspections. Study [6] examines the analysis of the effectiveness and efficiency of tax collection in Indonesia with the results of the inefficiency of the use of the DJP budget during 2012, where the realization of spending exceeded the budget plan in the APBN, reflecting the challenges in ineffective tax collection at the village level.

This study aims to improve the management of Land and Building Tax in villages through the development of an integrated information system that improves data accuracy and simplifies administration. In addition, this study will increase transparency by providing clear access to information regarding tax obligations, as well as reducing late payments through automatic reminder features. Operational efficiency will be improved by simplifying administrative processes and reducing system fragmentation. This study will also provide tools for financial reporting and auditing, as well as develop predictive models to analyze potential late tax payments.

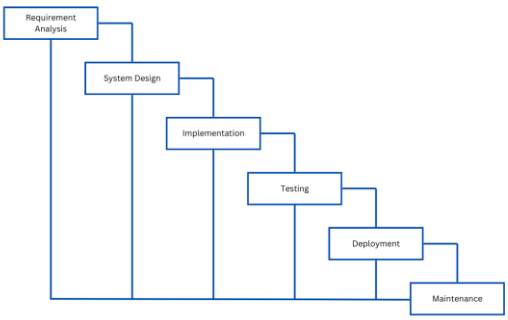


Figure 1. Waterfall Method Stages

II. METHODS

Figure 1 is the waterfall method stage. This process consists of Requirement Analysis, system design, implementation, testing deployment and maintenance. The following is an explanation of the waterfall method stages.

A. Requirements Analysis

The requirement analysis stage is the stage for analyzing user needs on the system to be created. The methods used are interviews, observations, and viewing archive data [7].

B. System Design

System architecture design aims to describe the overall structure of the system and the interactions between existing components[8]. At this stage, it is important to ensure that all parts of the system can function harmoniously and efficiently. Database design includes designing tables and relationships between tables in a database system, which will be implemented using MySQL [9]. This stage is crucial to ensure that data can be stored and retrieved efficiently, and supports the required system operations. The user interface design focuses on developing the appearance and how users interact with the system. This interface is designed to be intuitive and easy to use by the village community, making it easier for them to make land and building payment transactions. To describe the structure and function of the system more clearly, several visual aids are used, such as process flow diagrams that show the steps in using the system, entity relationship diagrams (ERDs) that explain the relationships between entities in the database, and user interface mockups that provide an initial overview of the appearance of the system to be developed[10].

C. Implementation

The implementation phase is the process of converting the system design into program code that can be understood and executed by the computer. In this phase, the developer

translates the technical specifications and interface design into the appropriate programming language to create a functional system[11].

D. Testing

At this stage, system testing is carried out using black box testing. The black box testing method aims to evaluate whether the functions in the system run according to the developer's expectations[12], without analyzing the source code in the system.

E. Deployment

This stage the information system will be implemented into the production environment. This process includes environmental preparation, system installation, and testing to ensure proper functioning[13]. End users are trained to use the system, and documentation is prepared to support management.

F. Maintenance

The maintenance stage is carried out to ensure the system is functioning optimally. This process includes bug fixes, software updates, and adding new features based on user feedback. Maintenance also includes periodic system monitoring to detect problems and maintain performance[14].

III. RESULTS AND DISCUSSION

A. Requirements Analysis

After conducting interviews with stakeholders in the Sub-district, it was identified that there are three levels of users who will use this predictive-based Land and Building Tax payment information system, namely administrators, admins, and users (taxpayers).

Administrator level users consist of tax government officials who are responsible for managing and monitoring the system. The main tasks of the administrator include setting up taxpayer data, managing payment transactions, and monitoring overall system performance. The administrator will also have access to generate reports related to land and building payments, monitor delays, and manage predictive features that provide analysis of taxpayer behavior. Thus, the role of the administrator is crucial in ensuring that the system functions properly and can provide accurate information for decision making.

The second level user is the admin[15], namely the village apparatus who will assist in land and building payments through the system if there are obstacles equipped with documentation. This admin will have access to the interface to view predictions of delays and taxpayer data in the related village and can download tax payment reports for archives in the village.

The third level user is the taxpayer, namely the community who will make land and building payments through the system. This user will have access to an interface designed for ease of use. Features available to taxpayers include checking the status and history of payments based on NOP (tax object number), as well as notification of payment due dates.

B. System Design

This stage aims to compile guidelines and illustrations on how the system will be developed. This process is very important because clear and structured system development will produce output as expected. This stage consists of several elements, including Entity-Relationship diagrams (ERD), Use Case diagrams, activity diagrams, flowcharts and user interface designs[16][17].

a. Use Case Diagram

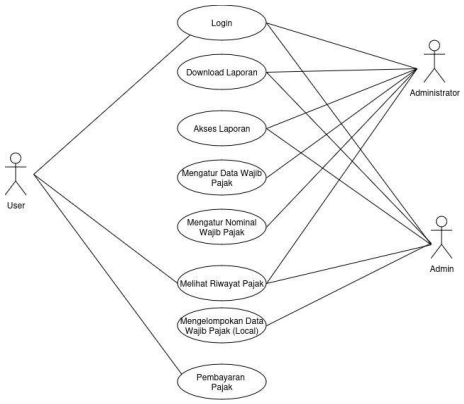


Figure 2. Use Case Diagram

Figure 2 is use case diagram that describes the interaction between the system and the user. This diagram helps visualize how users interact with the system and defines various usage scenarios[18].

B. Entity Relationship Diagram (ERD)

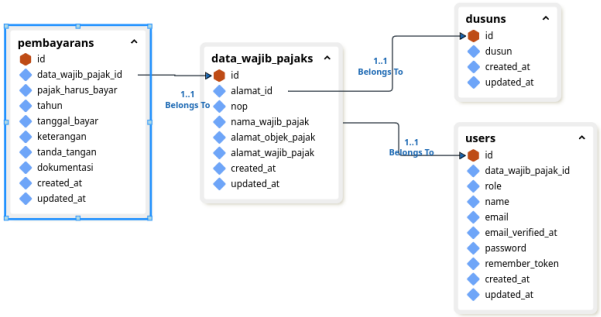


Figure 3. ERD

This diagram shows the database structure for the Land and Building Tax Payment Information System in a village, which consists of four main tables: Taxpayer Data, Payments, Users, and Hamlets.

C Payment Flowchart

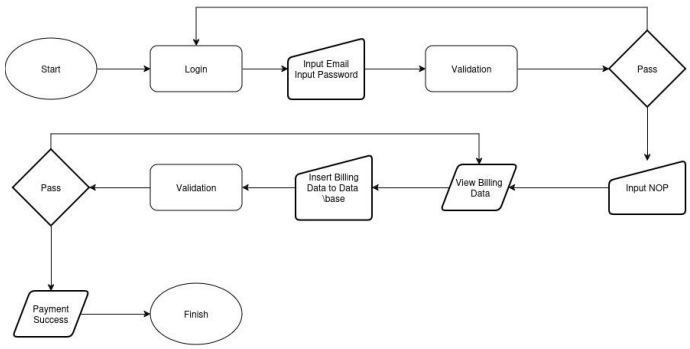


Figure 4. Payment Flowchart

The diagram above shows a series of steps and decisions required to carry out a process in a program. Each step in the process is represented in the form of diagram symbols, which are connected by lines or arrows to show the workflow[19].

D.Admin Activity Diagram

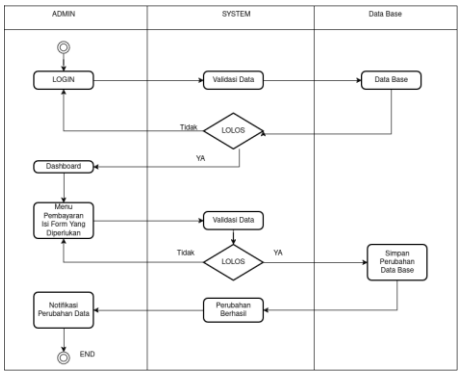


Figure 5. Admin Activity Diagram

The activity diagram above shows the interaction process between the admin, system, and database. The admin logs in, then the system validates the data. If successful, the admin is directed to the dashboard and can access the payment menu. After filling out the form, the data is validated by the system. If valid, the changes are saved in the database and the admin receives a notification that the changes were successful. If not, the admin is asked to correct the data. This diagram illustrates a simple flow to ensure accurate data validation and storage.

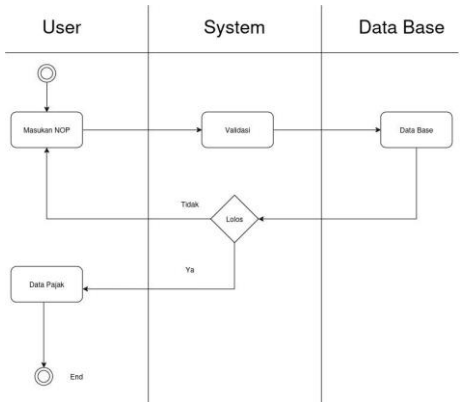


Figure 6. Admin Activity Diagram

The activity diagram above illustrates the user flow in the tax payment system. The user enters the NOP (Tax Object Number), which is then validated by the system. If the data passes validation, the user can view the related tax data. If not, the user is asked to correct their input. This diagram highlights the simple process between the user, the system, and the database to access tax information.

C. Implementation

At this implementation stage, the system design is converted into executable program code. The system is developed using*framework*Laravel is based on PHP and JavaScript programming languages. For the interface display, HTML and CSS are used, supported by the

Bootstrap framework. XAMPP was chosen as the web server to run this application during the development process[20].

a. Home Page

Figure 7. Main Page

The image above shows the Land and Building Tax Payment application interface. This application has a simple design with three main features displayed through three large buttons. village taxpayer data, payment, and check settlement.

b. Payment Data Page

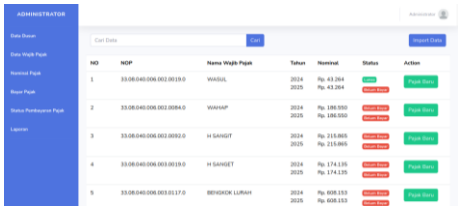


Figure 8. Admin Page

The image above shows the appearance of the Application Admin Dashboard which focuses on managing taxpayer data. In the main part of the page, there is a table that displays information related to taxpayers, such as NOP (Tax Object Number), Taxpayer Name, Tax Year, Nominal (amount of tax to be paid), Status (indicating whether the tax has been paid or not), and Action to add new taxes.

c. Payment Data Entry Page

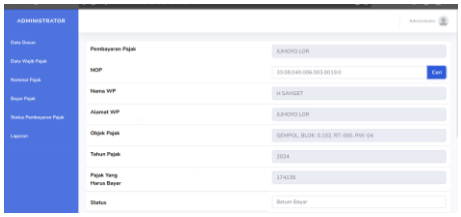
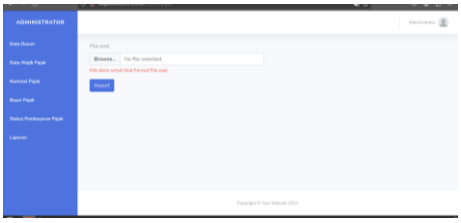


Figure 9. Payment Page

The form above is designed to enter tax payment data in the Application. After the admin or user enters the NOP and performs a search, information related to the taxpayer will automatically appear. The data displayed includes the taxpayer's name, address, tax object, tax year, and the amount of tax to be paid. payments are equipped with documentation to increase transparency and accountability Thus, this form not only functions as data input, but also as a tool to validate tax payment information based on the selected NOP.

d. Import Page



Page 10. Import Tax Page

The Excel import page in this application is designed to simplify and speed up the administrator in the process of entering taxpayer data. With this feature, the administrator can upload an Excel file that has been prepared according to the specified format. The format includes important columns such as Tax Object Number (NOP), Taxpayer Name, Address, and Tax Year.

e. Taxpayer Check User Page

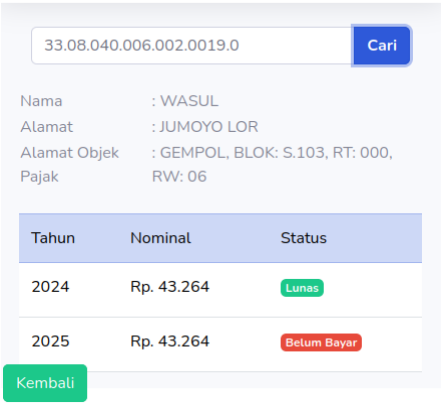


Figure 11. Tax Status Check Page

The payment status check page in this application is designed to make it easier for users, especially Taxpayers, to check their tax payment status based on their respective accounts. Each account has an NOP that can be used to check the payment history status. Users can only check their own accounts and cannot check the payment status of other users.

f. Taxpayer Report Page

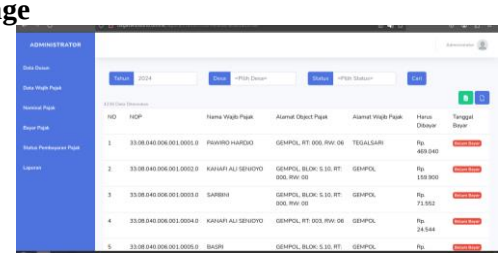


Figure 12. Tax Report Page

The taxpayer report page in this application is designed to provide convenience in managing data related to tax obligations. The main feature of this page is the ability to filter reports based on certain criteria, such as tax year, payment status, or taxpayer name. Admins and administrators can easily filter to display data that is relevant to their needs, making it easier

to analyze and make decisions. In addition, this page is also equipped with the option to download reports in the appropriate format, such as PDF or Excel.

g. Delay Prediction

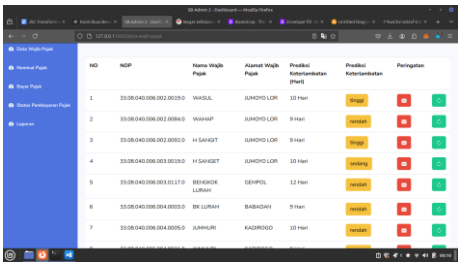


Figure 12. Delay prediction

Prediction of tax payment delays is done by utilizing historical data that has been filtered based on certain criteria, such as year, type of tax object, payment date, due date, and payment status. The number of predicted days of delay is taken from the number of days of delay in the previous period. The filtered data is used to identify taxpayers with a history of delays, then a decision tree analysis algorithm is applied to project the possibility of delays based on related variables. The results of this prediction allow the admin to group taxpayers based on the level of risk of delay.

h. Delay Risk Analysis

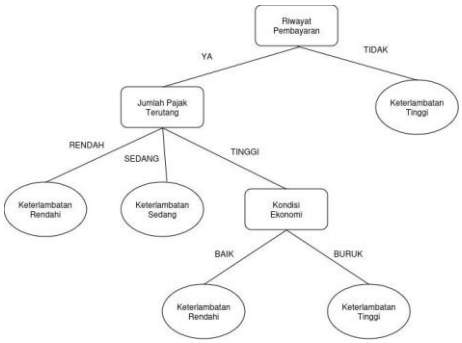


Figure 13 Decision tree delay analysis

The Decision Tree to predict late payment of Land and Building Tax begins by evaluating the taxpayer's Payment History. If there is a history of delay, the analysis continues to the Amount of Tax Payable, which groups taxpayers into low, medium, and high. In the medium tax group, economic conditions are examined; good conditions indicate lower delays, while poor conditions increase the risk of delays. With this approach, the Decision Tree helps identify factors that influence delays, allowing village governments to anticipate payment problems and improve tax management.

D. Testing

Table 1. Blackbox test

Test Name	Input / Test	Results
Login Validation	Email "admin@gmail.com" Password "Fuka_Wata123"	Successfully logged in and directed to the dashboard
Check Payment Status	NOP "33.08.040.006.002.0019.0"	The tax year and payment status appear.
Taxpayer Data Input	NOP "33.08.040.006.002.0025.0"	Data enters the database according to the format
Payment Process	NOP "33.08.040.006.002.0019.0 " Tax nominal "43,264"	Taxable funds and nominal appear, data is processed according to the nominal stated.
Check NOP Validation	NOP "33.08.040.006.002.0019.0 "	Valid NOP
Check Taxpayer Report	Filter by year, status and village	Data is displayed according to the filter
Late Reminder	Validate payment due date	7 days before the due date a warning appears
User Data Security Test	Direct access url without login	page returned to login
Check Notification Features	Validate due date and payment status	7 days, 5 days, 3 days, D-day a WA notification appears
Check Data Availability	NOP "2773.342.342.001"	Data appears as in the database
Test Access Without Login	dashboard url	Page redirects to login
Check Report Download	Filter the reports you want to download	Report successfully downloaded
Interface Responsiveness Test	Open applications on laptops, mobiles and iPads	Responsive display according to device size

table 2 presented the black box test. This test is used to find out whether the system is running well and producing results as expected.

4. CONCLUSION

Based on the research results regarding the Digital Transformation of Land and Building Tax Payments with a predictive information system, the following conclusions can be drawn:

1) This information system has three types of users, namely administrators, admins, and taxpayers, each of whom has different access and functions.
2) The system is equipped with various menus and features, including checking payment status, inputting taxpayer data, and predicting payment delays, which support efficient management of tax information[21].
3) Based on the background and objectives of the research, this system has succeeded in fulfilling its initial objectives to increase transparency and accountability in tax management, as well as providing accurate and timely information to users.
4) The results of black box testing show that the system functions without errors, with all features running as expected and providing the desired results.
5) The use of predictive algorithms in this system is effective in identifying taxpayers at risk of late payments, thus allowing for more proactive preventive measures from the village government.

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