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Implementation of Genetic Algorithms for Scheduling the Village Development Work Plan (RKPD) in Central Sulawesi Province

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Abstract: Effective regional development planning requires an integrated information system to support data management, decision-making, and scheduling processes. In Central Sulawesi Province, the facilitation of the Regional Development Work Plan (Rencana Kerja Pembangunan Daerah/RKPD) at the Regional Development Planning Agency (BAPPEDA) is still largely manual, resulting in inefficiencies, scheduling conflicts, and difficulties for Satuan Kerja Perangkat Daerah (SKPD) in meeting planning targets. This study proposes implementing a Genetic Algorithm (GA)-based scheduling information system to optimize RKPD facilitation activities. The system was developed using the waterfall methodology, encompassing requirement analysis, system design, implementation, testing, and maintenance. A web-based application integrated with a MySQL database was designed to automate scheduling, manage RKPD data, and monitor progress. The effectiveness of the system was evaluated using the DeLone and McLean Information System Success Model, focusing on system quality, information quality, and user satisfaction. The evaluation involved 12 users and demonstrated high average scores across all variables, indicating that the system is reliable, produces accurate and timely information, and is well accepted by users. The results show that the proposed system improves scheduling efficiency, supports consistent planning, and enhances decision-making. Therefore, the implementation of a Genetic Algorithm-based RKPD scheduling system is considered suitable and effective for supporting regional development planning at BAPPEDA Central Sulawesi Province.

Keywords: Genetic Algorithm; Optimization; Scheduling System; Development Planning; Decision Support System.

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1. Introduction

Planning and development in government today require the support of information systems to aid decision-making and management data. Management information systems and regional development planning are already widely used by the government. The purpose of development planning information systems is to improve information output and create consistent planning from the village to the national level [1]. Law No. 25 of 2004 concerning Planning Systems and Law No. 32/2004 concerning Regional Government enhance the rights and responsibilities of regional governments in managing resources, human resources, and potential. Regional government organizations must be able to create efficient and effective strategic and operational policies based on the principles of good governance to implement these rights and responsibilities.

Currently, the processing of RKPD facilitation data at the Central Sulawesi Province BAPPEDA in the preparation of development plans by Satuan Kerja Perangkat Desa (SKPD) often encounters obstacles. SKPDs struggle to prepare planning documents due to a lack of knowledge of planning regulations [2], supporting data on performance achievements/realizations, and budgets. Furthermore, they struggle to analyze performance achievements across time, regions, and relevance, resulting in program and activity targets not being achieved. Another problem is the manual processing of RKPD facilitation data at the Central Sulawesi Province BAPPEDA, which requires a limited timeframe for facilitation. This can certainly complicate facilitation data processing for budget effectiveness and efficiency [3]. This requires data synchronization, verification, validation, and integration, along with alternative action plan formulations to accelerate and accurately achieve organizational goals in the short, medium, and long term.

Scheduling problems such as these are classified as combinatorial optimization problems, which are difficult to solve using conventional methods. Genetic Algorithms (GA) have been widely applied to solve complex scheduling problems due to their ability to explore large search spaces and generate near-optimal solutions efficiently [4],[5]. Based on this background, the author will conduct a study entitled "Implementation of Genetic Algorithms in Rencana Kerja Pembangunan Daerah (RKPD) Scheduling in Central Sulawesi Province (Case Study: Regional Development Planning Agency of Central Sulawesi Province)." This system is expected to facilitate data processing and scheduling of RKPD facilitation at the Central Sulawesi Provincial Development Planning Agency Bappeda.

2. Methodology

The system development in this study adopts the waterfall model, which consists of requirement analysis, system design, implementation, testing, and maintenance. The waterfall method is suitable for structured system development with clearly defined requirements and sequential phases [6]. The Genetic Algorithm is applied as the core optimization technique for scheduling RKPD facilitation activities. GA operates through evolutionary processes such as population initialization, fitness evaluation, selection, crossover, and mutation to generate optimal scheduling solutions under multiple constraints [7], [8]. This approach has been proven effective in job-shop and project scheduling problems involving time constraints, deadlines, and resource allocation [9],[10].

The system is implemented as a web-based application supported by a MySQL database to manage RKPD data, scheduling information, and progress monitoring. Functional testing is conducted using the black-box testing approach to ensure that all system features operate according to user requirements [11].

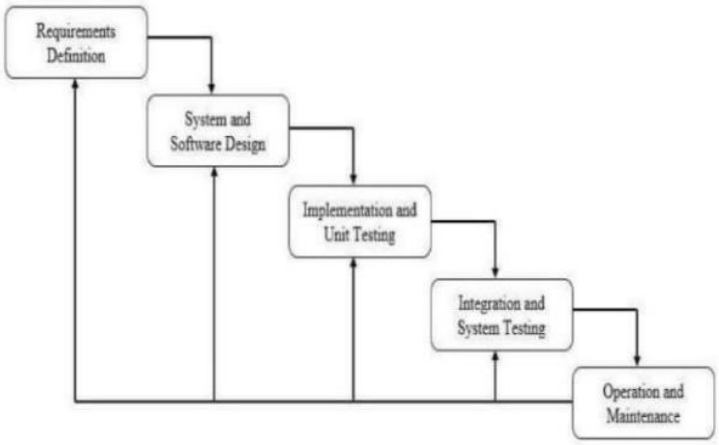

Figure 1. Waterfall Method

2.1. Requirements Analysis

At this stage, the author gathers information for the research using various methods, such as interviews, discussions, surveys, observations, and so on. In this case, the information required is data from the Regional Work Plan (RKPD) documents from the regencies or cities in Central Sulawesi Province, which are still being compiled manually. This research also lists the tools and materials the author will need.

2.2. System and Software Design

In this stage, the system specification information required in the previous stage is studied and analyzed and then implemented in the system design. After that, the system stages are designed by presenting the data relationships obtained in the form of document data that still uses manual methods for data processing, scheduling, and problem-solving. Next, the software interface and design are designed to meet the system's requirements.

2.3. Implementation and Unit Testing

In the implementation and unit testing phase, the author's application will test the unit functionality of each module implemented in the author's application to determine whether it provides a solution to the problem. Implementation of a website-based system and MY-SQL Database.

2.4. Integration and System Testing

At this stage, after all units have been tested and developed, all units are integrated into a single unit. After that, the entire system is tested to identify potential problems or errors within the system.

2.5. Operation and Maintenance

In this final stage, the RKPD scheduling information system that has been tested and operated by users will undergo maintenance. This maintenance includes repairs, developments, enhancements, and adjustments to the system as needed.

3. Results and Discussion

The developed system provides automated scheduling for RKPD facilitation activities and integrates data management features to support SKPD and BAPPEDA users. The use of Genetic Algorithms enables the system to generate feasible schedules that minimize conflicts and improve time efficiency compared to manual scheduling methods [12].

To evaluate system performance and user acceptance, this study employs the DeLone and McLean Information System Success Model, which measures system quality, information quality, and user satisfaction [13], [14]. This model is widely used to assess the success of information systems in organizational and public-sector contexts [15].

Evaluation results indicate that the system achieves high average scores for system quality, information quality, and user satisfaction. These findings demonstrate that the proposed system produces accurate, timely, and relevant information, while also being easy to use and responsive to user needs.

3.1. Use Case Diagram

A use case diagram is a model for the behavior of an implemented information system. Use cases describe the interactions between one or more actors in the information system being created. In short, a Use Case is an abstraction of the interactions between the system and its actors. Use case diagrams are used to illustrate who can use a system and what the system can do. A use case diagram is a diagram that illustrates the expected functionality of a system being developed. In a use case diagram, the emphasis is on what the system does, not how it does it. A use case represents an interaction between an actor and the system. This is used to briefly describe who can use the system and what the system can do.

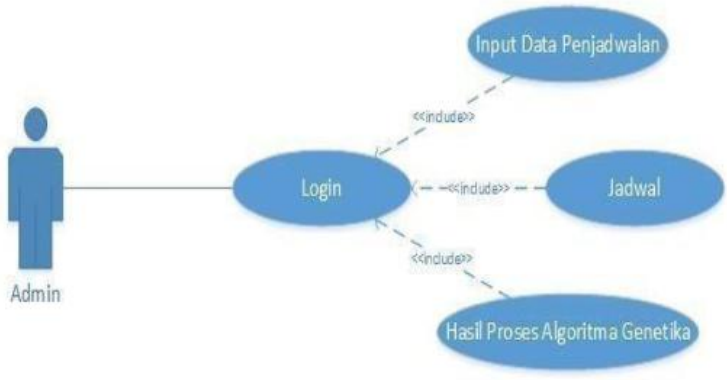

Figure 2. Use Case Diagram

Use case diagrams are used to illustrate who can use a system and what the system can do. A use case diagram is a diagram that illustrates the expected functionality of a system being developed. In a use case diagram, the emphasis is on what the system does, not how it does it. A use case represents an interaction between an actor and the system. This is used to briefly describe who can use the system and what the system can do.

3.2. Interface Application

The application interface is the visual display that connects the system and the user. The following is a preview of the application that has been built.

3.2.1. Form Login

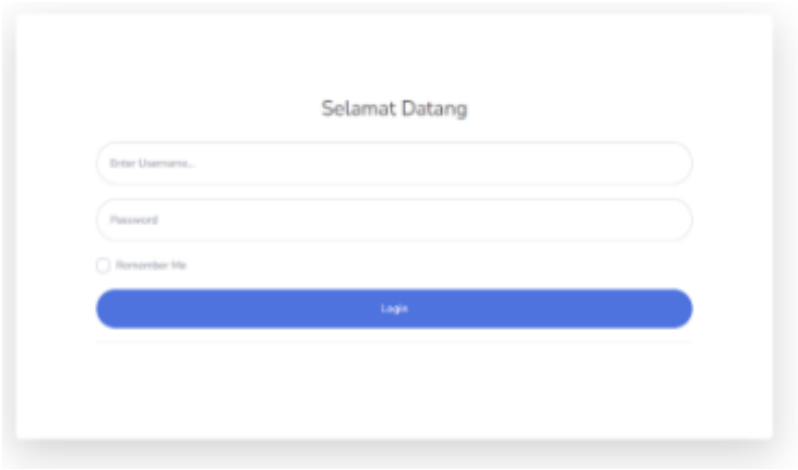

Figure 3. Login Form

The login input form is used to enter the registered username and password to access all system functions.

3.2.2. Dashboard Layout

Figure 4. Dashboard Layout

The dashboard form is the main display in the Implementation of Genetic Algorithms in Scheduling Rencana Kerja Pembangunan Daerah (RKPD) BAPPEDA of Central Sulawesi Province.

3.2.3. Meeting Data Layout

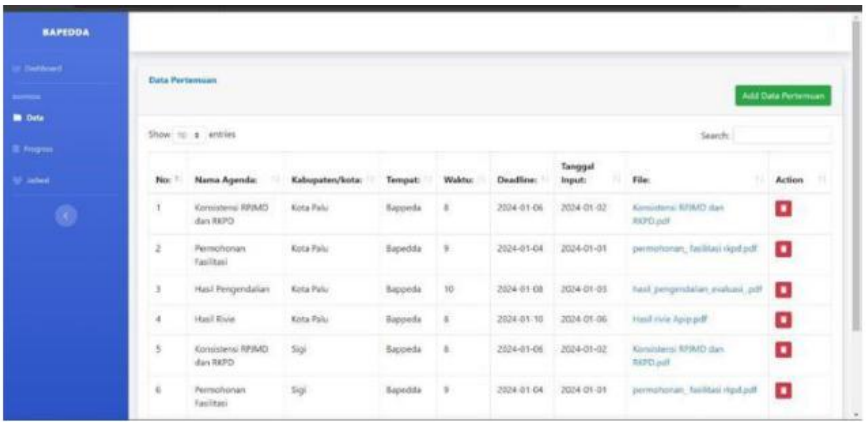

Figure 5. Meeting Data Layout

The data form is used to display meeting data entered by the admin. It includes fields for name/agenda, district/city, venue, time, deadline, input date, and file attachments. Action buttons are also added for editing.

3.2.4. Progress Data Layout

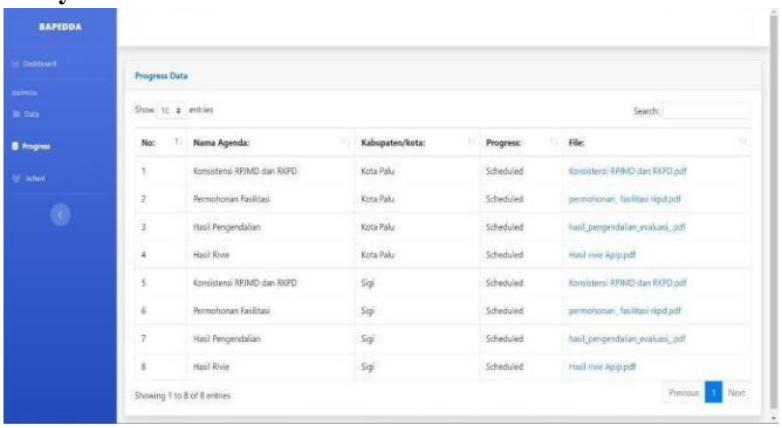

Figure 6. Progress Data Layout

The data progress form displays data on meetings scheduled by the system. This display contains fields such as agenda name, district/city, progress, and file attachments.

3.2.5. Meeting Scheduling Layout

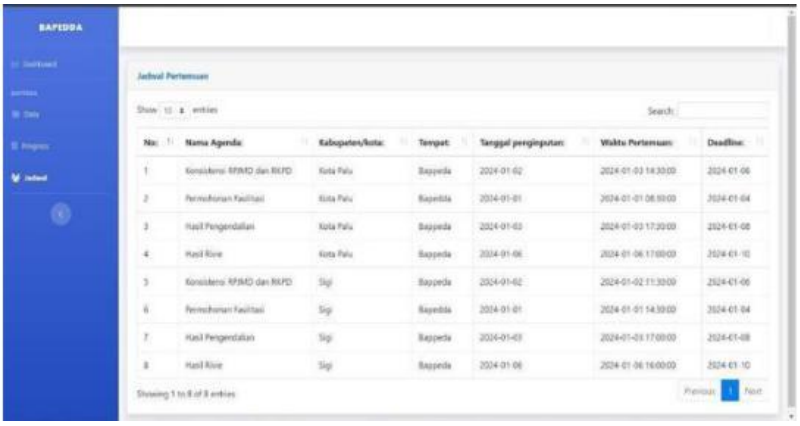

Figure 7. Meeting Scheduling Layout

The meeting schedule display displays the system-defined meeting schedule. The fields used include Name/Agenda, Regency/City, Venue, Date Entered, Meeting Time, and Deadline.

3.3. Database System

3.3.1 Admin Table

The admin table is used to store administrator account information for the system. It contains a unique identifier as the primary key, along with the administrator's username and password. This table supports the authentication process and helps control access to administrative features and system management functions.

Table 1. Admin Table

Field	Tipe	Panjang	Keterangan
id	int	11	primary key
username	varchar	255	
password	varchar	255	

3.3.2. Bappeda Table

This table stores detailed information related to records or submissions within the system. It includes a unique ID as the primary key, the name of the related entity, and location details such as regency/city and place. The table also records time-related information, including duration, deadline, and input date. Additionally, it stores the file associated with the record and tracks its current progress or status for monitoring and management purposes.

Table 2. Bappeda Table

Field	Tipe	Panjang	Keterangan
id	int	255	Primary key
nama	varchar	255	
kabkota	varchar	255	
tempat	varchar	255	
waktu	int	255	
deadline	date	-	
tanggalinput	date	-	
file	varchar	255	
progress	varchar	255	

3.4. DeLone and McLean Testing

The DeLone and McLean test was conducted using a questionnaire distributed to 12 users who would later use the system. The questionnaire consisted of three variables: system quality (5 questions), information quality (5 questions), and user satisfaction (4 questions). The questionnaire was developed based on the understanding of the indicators and references from several journals.

The table shows the average user responses for each DeLone and McLean variable. All variables achieved high average scores, indicating that users positively evaluated the system quality, information quality, and overall satisfaction.

Table 3. DeLone and McLean Model Testing

No	Variable	Number of Questions	Average Score
1	System Quality	5	4.2
2	Information Quality	5	4.0
3	User Satisfaction	4	4.3

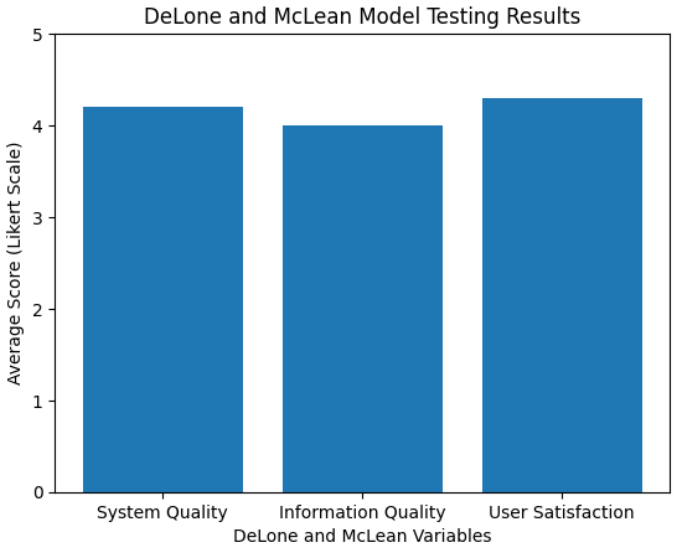

Figure 8. DeLone and McLean Model Testing

The bar graph displayed shows a comparison of the average values of the three DeLone and McLean variables System Quality: 4.2, Information Quality: 4.0 and User Satisfaction: 4.3. These results indicate that user satisfaction has the highest value, indicating that users are satisfied with the system being tested.

4. Conclusion

This study concludes that the implementation of a Genetic Algorithm-based RKPD scheduling information system effectively addresses the challenges faced by SKPD and BAPPEDA in the RKPD facilitation process. The system improves scheduling efficiency, supports consistent development planning, and enhances decision-making quality in regional development planning.

Based on the DeLone and McLean evaluation results, the system demonstrates strong performance in terms of system quality, information quality, and user satisfaction, indicating successful system adoption. Therefore, the proposed system is suitable for supporting regional development planning processes and can be further developed to support broader e-planning and decision-support applications in government institutions.Therefore, the proposed information system can be considered successful and suitable to support regional development planning processes, improve data management, and enhance the effectiveness of decision-making at BAPPEDA and SKPD levels, in line with applicable regulations and development planning objectives.

Author Contributions Statement

M. Fikry Rachma was responsible for the conceptualization of the study, system design, implementation of the genetic algorithm, data collection, system testing, and the preparation of the initial manuscript draft. Rahma Laila contributed to the research methodology, data analysis, result interpretation, manuscript review, and refinement of the discussion and conclusion sections. Both authors read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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