

# **Web-Based Bandwidth Configuration Automation Using Scheduling Algorithm**

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## **Abstract**

*PT Mora Telematics Indonesia continues to be committed to providing the best service to satisfy customers, both in terms of the quality of the products offered and the responsiveness in handling requests. However, the process of requesting bandwidth on demand, especially in activating requests that still use conventional configurations, causes inefficiencies and the potential for human error. This can reduce customer satisfaction and hinder the speed of response to bandwidth upgrade requests. As an alternative, a solution is designed in the form of a bandwidth configuration automation system based on the priority scheduling algorithm with the aim of increasing efficiency and accuracy in managing bandwidth requests on demand. This application was developed using a waterfall development model and based on a unified modeling language with a website platform to ensure ease of use. Application functionality testing shows satisfactory performance in each process, both at the billing and NOC levels, and the priority scheduling algorithm is proven to be able to read the end-date on the bandwidth on demand data correctly.*

**Keywords:** Bandwidth on demand, Network Management, Automation Configuration, Priority Scheduling, Web-Based Configuration

## **1. Introduction**

The telematics industry is growing rapidly as technology advances. One important aspect of telematics is bandwidth management, which is becoming increasingly important as demand for fast and reliable connectivity increases. The bandwidth upgrade application process is very crucial in ensuring that the network infrastructure can continue to meet user needs. However, even though technological advances have enabled automation in many aspects of network management, configuring bandwidth limitations is often still done manually or is less efficient. This can be caused by various obstacles, such as the complexity of the network infrastructure, lack of integration between different systems, or lack of understanding of available technologies.

*Bandwidth on demand (BOD) service is a temporary capacity increase service that is tailored to your needs (Amin et al. 2022). This service can be a fast and economical solution for large capacity internet needs, but only for a certain period of time. Although BOD provides flexibility to customers, there are still obstacles in the system's readiness to manage BOD requests efficiently. The main problem is the lack of efficiency in request management which is still done manually, as well as delays in the configuration rollback process after the BOD period ends. This can cause customer*

dissatisfaction and potentially cause losses for the company. Therefore, it is necessary to improve BOD management systems and processes to ensure optimal service and maintain business sustainability.

For this reason, companies feel the need to look for innovative solutions to optimize the automation management process for bandwidth limitation configurations. In order to achieve this, the application of the scheduling method is deemed very suitable for dealing with existing problems. The scheduling method is an approach to organizing and managing tasks in a system or process with the aim of optimizing resource use, meeting deadlines, reducing waiting times, and increasing operational efficiency (Afrianto and Wijaya 2024). Advantages include optimizing resource use, meeting deadlines, reducing waiting times, increasing operational efficiency, and the ability to adapt to changing conditions or priorities, thereby providing flexibility in dealing with dynamic situations.

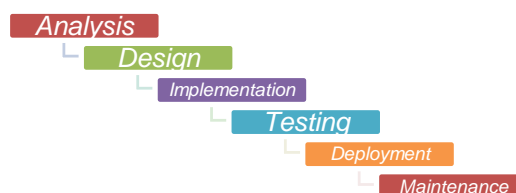
The algorithm that is often used in scheduling methods is the priority scheduling algorithm. The concept prioritizes tasks based on certain factors such as level of importance, completion time, or resource requirements. Tasks with higher priority are processed first (Dani Chairudin, Ginting, and Fajri 2020). The main advantage of this algorithm lies in its ability to optimize resource use by giving priority to important or urgent tasks (Sundari and Yogie Syahputra 2023). This can improve operational efficiency, ensure timely completion of critical tasks, and reduce wait times for lower priority tasks. Therefore, priority scheduling algorithms are very useful in environments where completing tasks with a certain priority is the key to achieving goals effectively.

The on-demand bandwidth configuration automation system will be designed using the PHP programming language. PHP is designed to form dynamic system pages, namely system pages that can form a display system based on system page requests (Putra, Kom, and Kom 2019) PHP is a universal programming language for handling the creation and development of a system and can be used in conjunction with HTML (Hartono 2021) For database management, MySQL is used, a database server that supports SQL language for interactive and fast data management (Wardani 2021).

Several previous studies (Setyawatu and Bachtiar Maulachela 2020) and (Rohmah and Gunawan 2023) have shown that the priority scheduling algorithm demonstrated its success in two separate studies, each of which applied it in a village population administration service information system and a car washing application. Although it has proven effective in both contexts, there is still potential for further development, such as integration with mobile applications to increase user convenience and efficiency. Therefore, further research regarding this algorithm is feasible.

## 2. Research Method

The system development method uses the waterfall method, also known as the waterfall model. Waterfall is a software development model that develops software systematically from one stage to the next, like the flow of a waterfall. The waterfall method has the advantage of producing quality systems through structured implementation, but requires effective management to avoid errors and uncertainties in the early phases of development (Prehant 2020).



Source: Research Result (2024)

Figure 1. Waterfall Method Steps

Figure 1 shows the steps in using the waterfall method with the following explanation.

### **2.1 Analysis**

Is a step in collecting information system requirements. To understand the basis of the program to be created, an analyst must understand the scope of information, required functions, desired performance capabilities, and user interface design on the information system (Hasanah 2020).

### **2.2 Design**

The system design process is in accordance with predetermined needs. The design stage includes designing class diagrams and sequence diagrams. Class diagrams describe the structure and description of classes, properties, methods and relationships of each object. Class diagrams are static. In other words, class diagrams do not describe what happens, but what relationships exist when the classes are connected (Prasetya, Sintia, and Putri 2022) while Sequence diagrams describe communication between the system and surrounding objects (including users, screens, etc.) in the form of messages described in real time. Sequence diagrams include a vertical dimension (time) and a horizontal dimension (related things) (Indriyani et al. 2019).

### **2.3 Implementation**

This process involves the transformation of software designs into programming languages that can be understood by computers through the coding process (Ma'arif 2020). This stage is the implementation stage of the design that has been designed by the programmers.

### **2.4 Testing**

This process is a system testing process to ensure that the system built is error-free and in accordance with predetermined needs. Testing is carried out using the blackbox method. black box testing is a software functional testing method designed for small units and integrated results from the perspective of end-user applications (Septilia, Parjito, and Styawati 2020).

### **2.5 Deployment**

At this stage, implementation, improving, evaluating, and developing the system based on feedback from users will be carried out. At this stage, it is intended that the system can operate and develop according to its function.

### **2.6 Maintenance**

At the last stage in the waterfall method, system maintenance will be carried out if necessary.

## **3. Results and Analysis**

The results of the analysis and discussion related to the design of an on-demand bandwidth configuration automation system will be presented in stages according to the waterfall method with the following results.

### **3.1. Analysis**

After conducting observations, several problems were found in the form of the On Demand Bandwidth request management system which was still limited because it was done manually by the Network Operations Center (NOC) team. This causes delays in the process of returning the bandwidth configuration to its original state after the Bandwidth On Demand period ends, as well as in processing Bandwidth On Demand

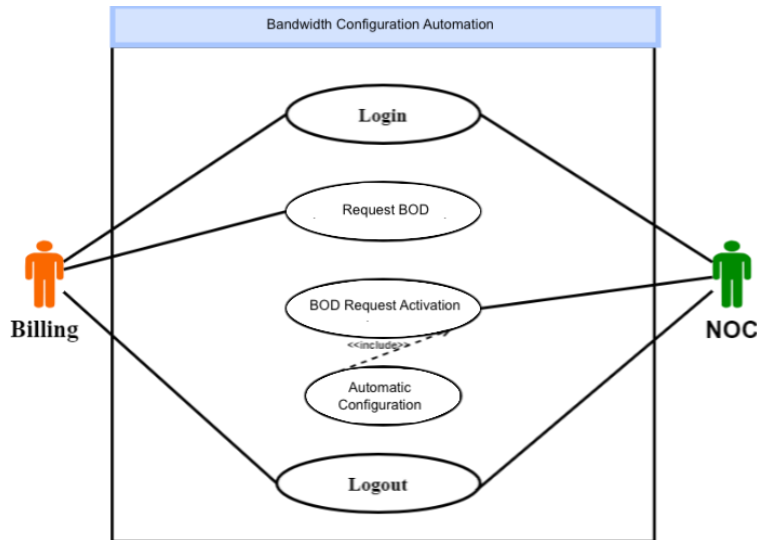
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requests, which could potentially cause financial losses for the company. Apart from that, this system is less capable of managing large volumes of requests and monitoring incoming requests is less effective.

### 3.2. Design

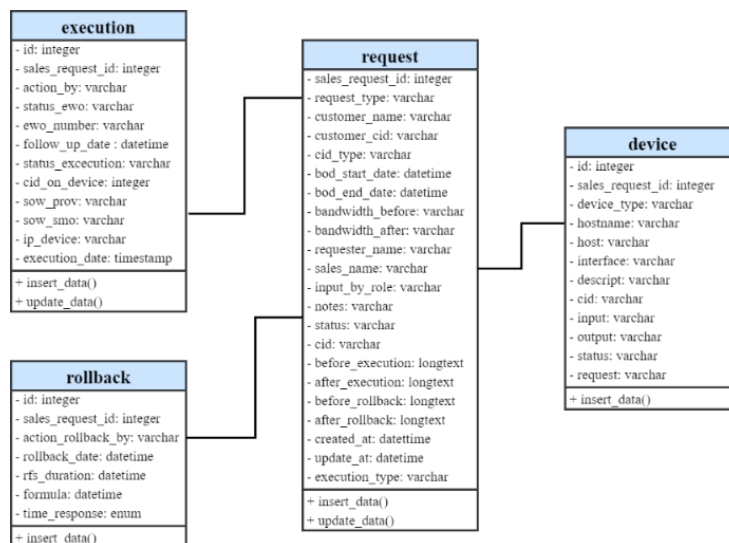
System design consists of designing use case diagrams, class diagrams, and sequence diagrams. Use case diagrams are used to describe application users and the behavior that users perform against the application. The application use case diagram can be seen in Figure 2.



Source: Research Result (2024)

Figure 2. Use Case Diagram

Figure 2. Explains that there are two actors, namely Billing and NOC, Billing is the Actor who has access to manage bandwidth on demand requests and NOC is the Actor who has access to activate bandwidth on demand requests that have been submitted by the billing party.

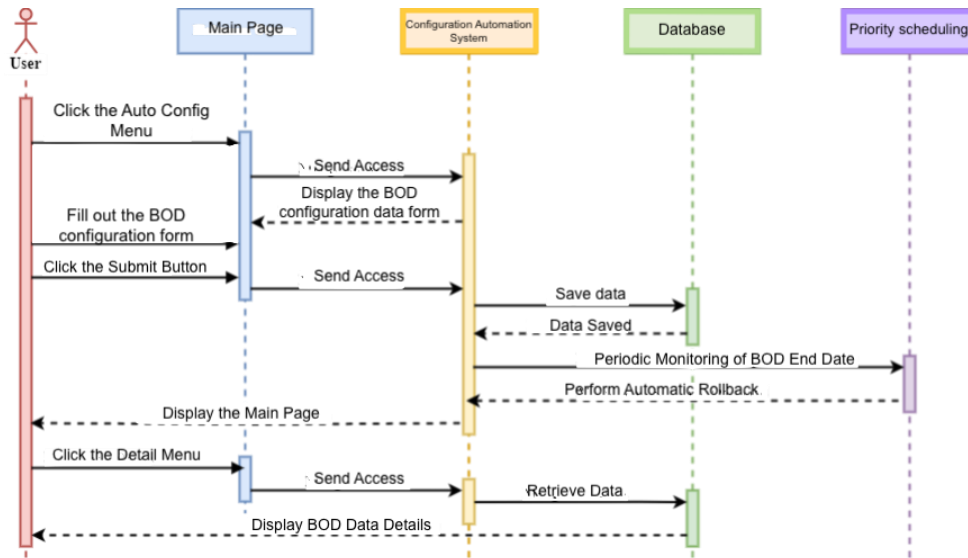


Source: Research Result (2024)

Figure 3. Class Diagram

Class diagram is a diagram that describes the structure of the system in terms of defining the classes that will be created to create the system. These classes have attributes and methods or operations. The class diagram of the Reed Solomon Algorithm-based Digital Description Card system can be seen in Figure 3.

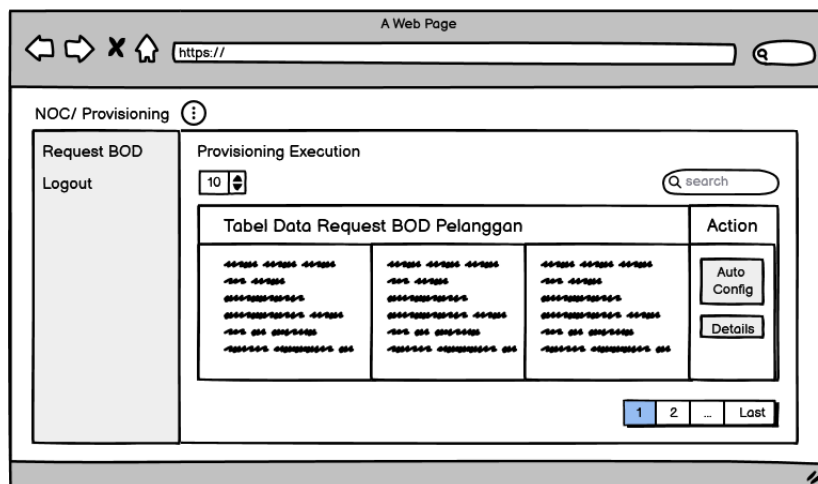
Sequence Diagrams are used to visualize behavior in a scenario or a sequence of steps taken in response to an activity to produce an output.



Source: Research Result (2024)

Figure 4. Sequence Diagram Auto Config BOD

Figure 4. explains the interaction between the user and the system in activating a BOD request. The NOC user clicks on the auto-configuration menu, which sends access to the main page and displays the BOD configuration form. The user fills out a form, which is then processed by the system to save the data to the database and confirm saving. Priority scheduling periodically monitors BOD end dates and performs automatic rollbacks if necessary. Users can also click on the details menu to access the main page which displays BOD details taken from the database.



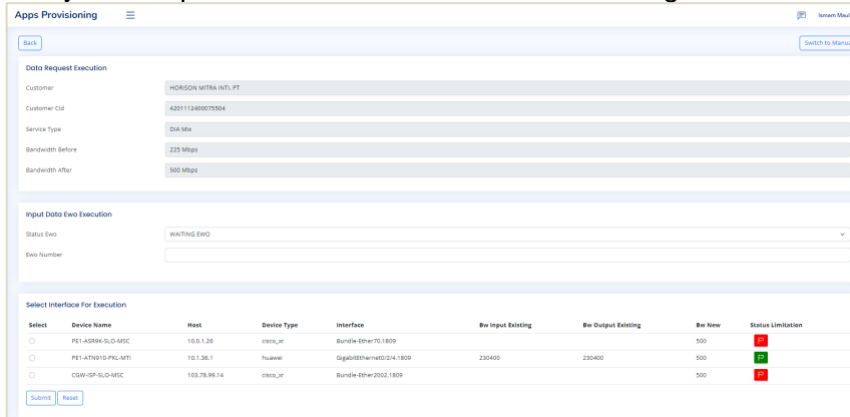
Source: Research Result (2024)

Figure 5. BOD Activation Menu Mockup

Figure 5. Describes the design of the network activation interface where the NOC can access the auto config menu on the right side of the table where this menu will display a form that can be filled in and the NOC can choose which device will be activated and start the auto configuration process.

### 3.3. Implementation

The system implementation stage is a stage in creating a system based on designs that have been carried out previously. The following is a display of the application or system implementation which can be seen in Figure 6.



Source: Research Result (2024)

Figure 6. BOD Activation Menu Display

This section involves matching data generated from the system database with BOD request data (start date and end date). This data can be explained as below.

No.	Request Date/Time	Request ID	Customer ID	Bandwidth on Demand		Bandwidth Capacity		Auto Config	
				start	end	before	after	Aktivasi BOD	Rollback BOD
1	01/03/2024 12:01	1145	447041210008251	01/03/2024	03/03/2024	2800	5000	01/03/2024 13:51	04/03/2024 00:00
2	03/03/2024 22:55	1148	415421240007444	04/03/2024	05/03/2024	100	150	03/03/2024 23:34	06/03/2024 00:00
3	03/03/2024 23:02	1149	368276010006485	04/03/2024	04/03/2024	300	320	03/03/2024 23:32	05/03/2024 00:01
4	04/03/2024 11:01	1151	447041210008251	04/03/2024	06/03/2024	2800	5000	04/03/2024 11:06	07/03/2024 00:00
5	04/03/2024 22:18	1153	453931240008259	05/03/2024	05/03/2024	100	200	05/03/2024 08:14	06/03/2024 00:01
6	05/03/2024 17:34	1158	168336010006487	06/03/2024	06/03/2024	200	250	05/03/2024 17:43	07/03/2024 00:00
7	05/03/2024 17:39	1159	138156010006570	06/03/2024	08/03/2024	300	600	05/03/2024 17:42	09/03/2024 00:00
8	12/03/2024 16:56	1166	457341240008339	13/03/2024	15/03/2024	40	60	12/03/2024 16:57	18/03/2024 07:54
9	15/03/2024 08:56	1174	425751240007666	19/03/2024	19/03/2024	100	200	15/03/2024 08:56	20/03/2024 00:00
10	17/03/2024 12:23	1176	331656010005596	17/03/2024	22/03/2024	200	500	17/03/2024 12:41	23/03/2024 00:00
11	20/03/2024 12:34	1186	460191240008416	20/03/2024	24/03/2024	150	225	20/03/2024 12:34	25/03/2024 00:00
12	21/03/2024 12:33	1196	447041210008251	21/03/2024	03/04/2024	2800	4000	21/03/2024 12:34	04/04/2024 00:01
13	21/03/2024 17:07	1201	158881250008136	22/03/2024	24/03/2024	200	300	21/03/2024 17:08	25/03/2024 00:00
14	22/03/2024 09:01	1203	117811210006966	25/03/2024	24/04/2024	1000	2000	22/03/2024 09:01	25/04/2024 00:01
15	24/03/2024 11:28	1206	165236010003473	25/03/2024	25/03/2024	250	375	24/03/2024 11:32	26/03/2024 00:00
16	24/03/2024 15:56	1207	122496010001324	25/03/2024	25/03/2024	1000	1300	25/03/2024 08:02	26/03/2024 00:00
17	28/03/2024 08:53	1235	447111240008094	28/03/2024	28/03/2024	120	180	28/03/2024 09:35	29/03/2024 00:00
18	02/04/2024 16:15	1246	201546010003797	02/04/2024	04/04/2024	200	400	02/04/2024 16:27	05/04/2024 00:00
19	03/04/2024 10:24	1248	138156010006871	19/04/2024	24/04/2024	800	2000	03/04/2024 10:24	02/05/2024 10:05
20	18/04/2024 08:55	1258	138156010006570	19/04/2024	19/05/2024	300	700	18/04/2024 08:55	20/05/2024 00:01
21	18/04/2024 11:47	1260	315056010005225	18/04/2024	18/04/2024	5	6	18/04/2024 11:49	19/04/2024 00:00
22	22/04/2024 15:14	1264	169291240008056	23/04/2024	25/04/2024	10	400	22/04/2024 15:18	26/04/2024 00:01
23	23/04/2024 12:43	1269	67051210003769	23/04/2024	23/04/2024	550	750	23/04/2024 12:45	24/04/2024 00:01
24	23/04/2024 12:43	1270	67052010003769	23/04/2024	23/04/2024	550	750	23/04/2024 12:44	24/04/2024 00:01
25	24/04/2024 14:26	1277	214396010003896	24/04/2024	25/04/2024	50	100	24/04/2024 14:28	26/04/2024 00:01
26	27/04/2024 12:02	1280	252931240008254	29/04/2024	30/04/2024	300	450	28/04/2024 10:28	01/05/2024 00:00
27	28/04/2024 18:46	1282	443461240008015	29/04/2024	03/05/2024	250	375	28/04/2024 18:53	04/05/2024 00:01
28	28/04/2024 18:48	1283	169291240008056	28/04/2024	30/04/2024	10	400	28/04/2024 18:54	01/05/2024 00:00
29	28/04/2024 18:51	1284	190526010005336	29/04/2024	29/04/2024	120	180	28/04/2024 18:55	30/04/2024 00:01
30	29/04/2024 16:28	1287	252931240008254	29/04/2024	30/04/2024	300	600	29/04/2024 16:34	01/05/2024 00:00
31	29/04/2024 23:04	1288	317434130005955	30/04/2024	30/04/2024	100	200	29/04/2024 23:18	01/05/2024 00:00

Source: Research Result (2024)

Figure 7. Breakdown of BOD request data

Figure 7. is a breakdown of BOD request data (including request data, activation data and rollback data) at PT Mora Telematics Indonesia Tbk. It can be seen that the system is able to provide the correct configuration, read the end date of the request, and automatically perform a rollback on devices that have been reached the service deadline. Data shows that the system takes approximately 1-5 minutes to execute automatic configuration upon service activation and rollback.

### 3.4. Testing

The testing phase of this system aims to test and evaluate the extent to which the system can work according to the expected functionality. The testing method used to test the stability of this data warehouse processing application uses the black box testing method. This method focuses on system functionality in terms of system input and output. The test results can be seen in Table 1.

Table 1. Blackbox Testing

No.	Menu	Scenario Testing	Expected Result	Result
1	Home page website	access the website	The system displays the front page of the website and displays the login form	✓
2	Login	enter username and password	The system displays the login page if successful and will display the main page	✓
3	Add BOD menu	access the Add BOD menu	The system successfully displays the Add BOD form which can be filled in according to the BOD request data.	✓
4	Add BOD request data	fill in the form to add BOD request data then click save	The system has successfully saved the data by displaying the saved data message and displaying the main page.	✓
5	Data request edit submenu	access the edit action button	The system successfully displays the BOD data edit form which can be filled in according to the desired data changes	✓
6	Edit BOD request data	fill in the data change form then click save	The system successfully saves data changes by displaying the saved data message and displaying the main page.	✓
7	Submenu cancels data request	access the cancel action button	The system successfully displays a confirmation pop-up that can be selected	✓
8	Cancel BOD data request	cancel the customer's BOD request on the confirmation form	The system successfully deactivates the data and actions on the request and displays the main page.	✓
9	Details of Directors' Request	access detailed action buttons	The system displays pop-up information including: BOD data, Execute BOD and Rollback BOD and Return displays the main page.	✓
10	Auto Configuration submenu	access the Auto Config submenu on the autoconfig action button	The system successfully displays the BOD Execution request form which can be filled in according to the BOD request data.	✓
11	Execution Page	Select the interface device that will auto configure BOD	The system successfully saves the data while configuring the selected device, the system works behind the scenes by auto monitoring end date	✓

No.	Menu	Scenario Testing	Expected Result	Result
12	Logout	Click the logout menu	data in 5 minutes/cycle and performing auto rollback on the data end date closest to the auto monitoring time and displaying the main page. The system will remove the admin from the system and display the main website page (login display)	✓

Source: Research Result (2024)

### 3.5. Deployment

The next stage will involve implementing, improving, evaluating, and developing the software in accordance with customer feedback using cutting-edge technologies such as Artificial Intelligence (AI) and Machine Learning (ML) algorithms to enhance predictive analytics and real-time decision making, cloud-based infrastructure utilizing Amazon Web Services (AWS), Microsoft Azure, or Google Cloud Platform (GCP) for scalability, security, and high availability, DevOps practices leveraging tools like Jenkins, Docker, and Kubernetes to streamline the development and deployment process, and Natural Language Processing (NLP) techniques for sentiment analysis and text classification to improve customer engagement and support.

### 3.6. Maintenance

This final stage of the waterfall methodology involves carrying out routine maintenance tasks as needed to ensure the software system continues to operate reliably and efficiently. This includes ongoing support and updates to ensure its stability, performance, and security, with active collaboration with users to gather feedback and insights that inform the development of new features, bug fixes, and enhancements, ultimately delivering value-added services and experiences that meet the evolving needs of the end-users.

## 4. Conclusion

Based on research on priority scheduling-based bandwidth configuration automation systems at PT Mora Telematics Indonesia Tbk, several conclusions have been drawn. The bandwidth configuration automation system helps companies end Bandwidth On Demand requests more effectively and efficiently. This performance system improves Bandwidth On Demand request services and customer satisfaction through faster responses. The priority scheduling algorithm is able to read the end date of requests accurately, reducing potential losses due to rollback delays. Testing shows that the system provides appropriate responses and expected output. Testing shows that the system provides appropriate responses and expected output. Additionally, the use of this automation system results in reduced operational costs and improved resource utilization. By automating bandwidth configuration tasks, companies can also minimize the risk of human error and ensure consistency across all systems. Furthermore, the system's ability to prioritize requests based on their urgency and importance enables businesses to respond quickly to changing market conditions

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## Author Contributions

Dwipa Handayani and Muhammad Ismam Maulana proposed the topic Muhammad Ismam Maulana models and designed the experiment; Dwipa Handayani monitors the research topic; Dwipa Handayani and Muhammad Ismam Maulana analyzed the results.

## Conflicts of Interest

The author declares no conflict of interest.

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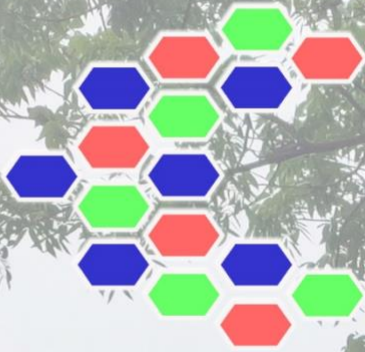


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From Editor-in-Chief

لَسَّلَامٌ عَلَيْكُمْ وَرَحْمَةُ اللَّهِ وَبَرَكَاتُهُ



Rahmadya T. Handayanto, Ph.D.  
Editor-in-Chief

Best wishes to all the members of Editorial Board, Reviewers Panel, Authors and Readers of PIKSEL for a very happy, and stay healthy.

Global challenges and local advancements increasingly rely on innovations in data science, machine learning, and technology. This edition presents a diverse collection of research exploring the applications of these fields in education, business, healthcare, network security, and local governance.

The studies featured in this volume highlight how technological advancements enhance efficiency, accuracy, and user experience across various domains. From the development of intelligent user interfaces that improve accessibility in business applications to the implementation of machine learning for decision-making, these contributions demonstrate the transformative impact of technology. Additionally, innovations in medical diagnostics, smart cities, education, and cybersecurity showcase the critical role of computational methods in addressing real-world challenges.

This edition also includes research on mobile technology, sentiment analysis, and risk assessment in system migration. Notably, for the first time, environmental concerns are discussed, particularly in the context of waste management—one of the pressing issues in cities across

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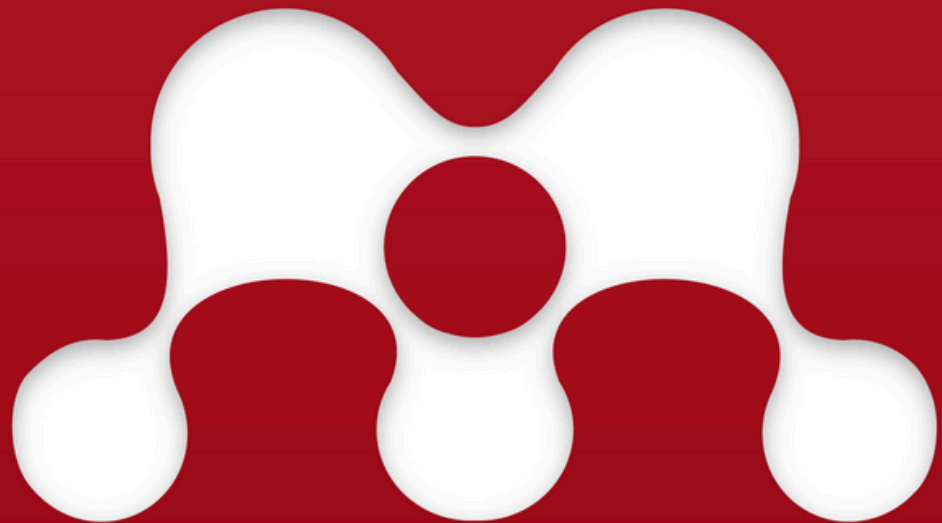
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