Design of an Integrated Public Complaint Information System Based on Web and WhatsApp Gateway

Abdul Khaliq, Ruly Dwi Arista, Banyu Yusadewo

Abstract

The rapid growth of digital technology has transformed how public services are delivered, requiring faster, more transparent, and more accessible channels for handling citizen complaints. This study aims to design and implement an Integrated Public Complaint Information System based on a web platform and a WhatsApp Gateway to support real-time communication and improve responsiveness in public service environments. The system was developed using the Prototyping Model, allowing iterative refinement based on user feedback. The integration of the WhatsApp API enables citizens to submit complaints through familiar communication channels, while the web-based dashboard allows administrators to manage, verify, and respond to complaints efficiently. Functional testing using the Blackbox Testing method indicated a 97.5% success rate, demonstrating that all key features operated according to the defined requirements. System performance evaluation using the Response Efficiency Index (REI) achieved a score of 90%, showing that the majority of complaints were handled within the acceptable service time. User satisfaction measurement also resulted in an 80% User Satisfaction Index (USI), indicating that citizens found the system easy to use, responsive, and reliable. The results show that integrating a WhatsApp Gateway with a web-based complaint system significantly enhances accessibility, transparency, and service efficiency. This system can serve as a practical solution to support digital transformation initiatives in public service management.

***Keywords**:* Public Complaint System; WhatsApp Gateway; Web-Based Information System; Prototyping Model; Blackbox Testing; Response Efficiency; User Satisfaction; Digital Public Service.

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Introduction

The evolution of information and communication technology has significantly transformed the landscape of public service delivery. In the era of digital governance, the effectiveness and responsiveness of government services depend heavily on the ability to provide fast, transparent, and accessible channels for citizen engagement [1]. The emergence of *electronic government* (e-government) has become a key driver for improving the efficiency and accountability of public administration processes [2].

In Indonesia, the implementation of e-government has been promoted through various national and regional initiatives aimed at increasing public participation and transparency. However, despite substantial investments, many e-government systems continue to face barriers such as fragmented infrastructure, low interoperability between institutions, and limited digital literacy among citizens [3]. These challenges have hindered the optimal adoption and effectiveness of digital public service platforms.

A vital component of e-government systems is the *public complaint information system*, which enables citizens to report issues, submit feedback, and monitor responses from government agencies [4]. Complaint systems serve as essential tools for accountability, empowering citizens to evaluate the performance of public institutions. The Indonesian government launched the *SP4N-LAPOR!* (Sistem Pengelolaan Pengaduan Pelayanan Publik Nasional) platform as a centralized mechanism for collecting and managing citizen complaints via web and mobile interfaces [5]. However, several studies reveal that users often encounter difficulties in submitting complaints and tracking their resolution, largely due to complex user interfaces and delayed responses [6].

To address these shortcomings, new approaches that integrate familiar and widely used communication technologies are being explored. WhatsApp, as one of the most popular messaging applications in Indonesia, provides a user-friendly and real-time medium for communication between citizens and public authorities [7]. Governments around the world have started using WhatsApp-based gateways for public service delivery, as demonstrated by initiatives in India and Brazil, which report increased accessibility and improved response rates [8].

Integrating a web-based complaint information system with a WhatsApp gateway presents a promising solution for enhancing citizen participation and service efficiency. Such integration allows for multi-channel access — enabling citizens to lodge complaints via either the web platform or WhatsApp — and ensures automated message handling through APIs. Moreover, this hybrid system design supports real-time notifications and transparent tracking of complaint status, aligning with the goals of *smart governance* and *digital transformation*.

This study focuses on designing and implementing an *Integrated Public Complaint Information System* based on a web interface and WhatsApp gateway. The proposed system aims to simplify complaint submission, facilitate automatic response acknowledgment, and improve data management for relevant government departments. By combining web technologies and mobile messaging APIs, the system seeks to enhance the overall responsiveness, transparency, and effectiveness of public complaint handling in Indonesia.

Literature Review

2.1 Information System

An information system is a combination of hardware, software, databases, networks, and human resources that work together to collect, process, store, and distribute data to support decision-making in an organization [1].

According to O'Brien, information systems not only serve as tools for data processing but also act as a foundation for modernizing organizational performance and improving public services [2].

In the context of public administration, implementing information systems allows service processes to become more efficient, transparent, and easily accessible to citizens [3]. A well-designed information system can also improve accountability and accuracy in handling public reports and complaints.

2.2 Public Complaints

A public complaint is a form of community participation that allows citizens to provide feedback, report problems, or express dissatisfaction with public services [4].

An effective complaint management system should provide two-way communication, transparency, and a structured follow-up mechanism. Through a web-based complaint system, users can submit reports quickly, monitor progress, and receive responses directly from administrators [5].

Integrating public complaint systems with communication platforms such as WhatsApp expands accessibility and promotes greater citizen engagement in the reporting process [6].

2.3 WhatsApp Gateway

A WhatsApp Gateway is an Application Programming Interface (API) that enables integration between an external system and the WhatsApp platform to send and receive messages automatically [7].

Unlike the regular WhatsApp application, the gateway allows automation through approved message templates, supports large-scale communication, and integrates directly with web-based back-end systems through *webhooks* [8].

The use of WhatsApp Gateway in public service applications provides real-time communication, automated notifications, and easy message handling between users and administrators.

This approach enables institutions to respond to reports faster and improve interaction quality.

In India, for example, the implementation of WhatsApp-based public service programs such as *Mana Mitra* has demonstrated increased efficiency and citizen satisfaction in communication between communities and local governments [9].

2.4 Prototyping Method

The *Prototyping* method is a software development approach used to build an early version of a system (*prototype*), which is refined based on continuous user feedback [10]. This iterative and interactive process generally consists of five stages:

1. requirements communication,
2. quick planning and design,
3. prototype construction,
4. user evaluation, and
5. iterative refinement until a final product is achieved [11].

The prototyping model is suitable for projects involving high user interaction, such as public complaint systems, because it allows developers to validate requirements and ensure that the system meets real user needs [12].

2.5 Blackbox Testing

Blackbox Testing is a software testing technique that focuses on validating system functionality by analyzing inputs and outputs without considering the internal code structure [13].

This testing method ensures that the system behaves as expected under specific input conditions and that all functions work according to user requirements [14].In this study, Blackbox testing is applied to validate key features such as message submission via the WhatsApp Gateway, data storage in the web system, and notification feedback to users.

2.6 Related Studies

Several previous studies have explored the integration of web technology and communication platforms to enhance the quality of public service delivery.

Nasrulloh and Nurhasanah (2025) developed a web-based public complaint system using the Naïve Bayes algorithm for automatic classification, which successfully improved response speed and prioritization [15].

Meanwhile, Pate (2025) emphasized that social media and messaging applications like WhatsApp have become effective tools for promoting citizen participation due to their accessibility and widespread use [16].

Cortés-Cediel (2023) further discussed the implementation of *chatbots* in e-government systems, highlighting their ability to improve user experience, responsiveness, and efficiency in public service delivery [17].

Based on these studies, integrating a web-based information system with a WhatsApp Gateway can significantly improve communication, speed, and transparency in managing public complaints.

3. Research Methodology

3.1. Research Approach

This study applies the Prototyping Model as the main approach to system development. The method allows iterative interaction between developers and users, enabling continuous feedback and improvement until the final version meets user needs [1]. The research process consists of several phases:

1. Requirements Communication – Collecting user needs and functional specifications from stakeholders.
2. Quick Design – Creating an early system structure and interface design.
3. Prototype Construction – Developing the preliminary version of the system, integrating both the web module and WhatsApp API.
4. User Evaluation – Testing the prototype with real users to collect usability and functionality feedback.
5. Refinement and Finalization – Revising and optimizing the system based on evaluation results until the final version is ready for deployment.

The overall process is illustrated in Fig. 1.

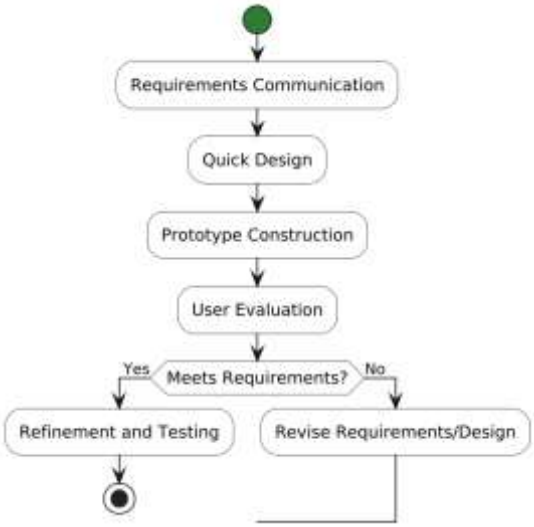

Figure 1. Research Approach

3.2. System Design

1. System Architecture

The architecture integrates a Web-based application and a WhatsApp Gateway through RESTful APIs. The system is divided into three main layers (see Fig. 2):

1. Presentation Layer – The user interface accessed via a web browser or WhatsApp.
2. Application Layer – Handles complaint management, routing, notifications, and chatbot logic.
3. Data Layer – Stores all complaint records, user data, and response logs in a MySQL database.

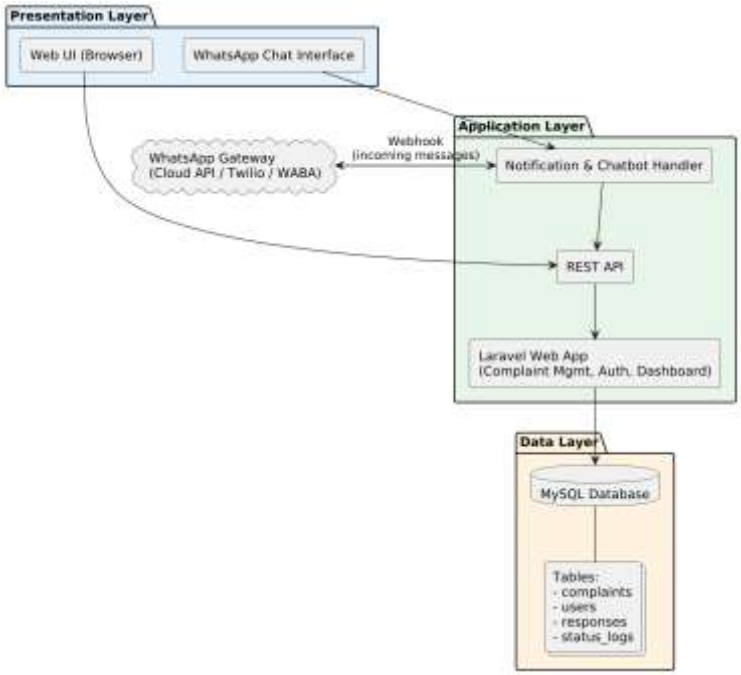

Figure 2. System Architecture (Component/Layered Diagram)

3.3. Data Flow Design

The data flow diagram (DFD Level 0) of the proposed system is shown in **Fig. 3**.

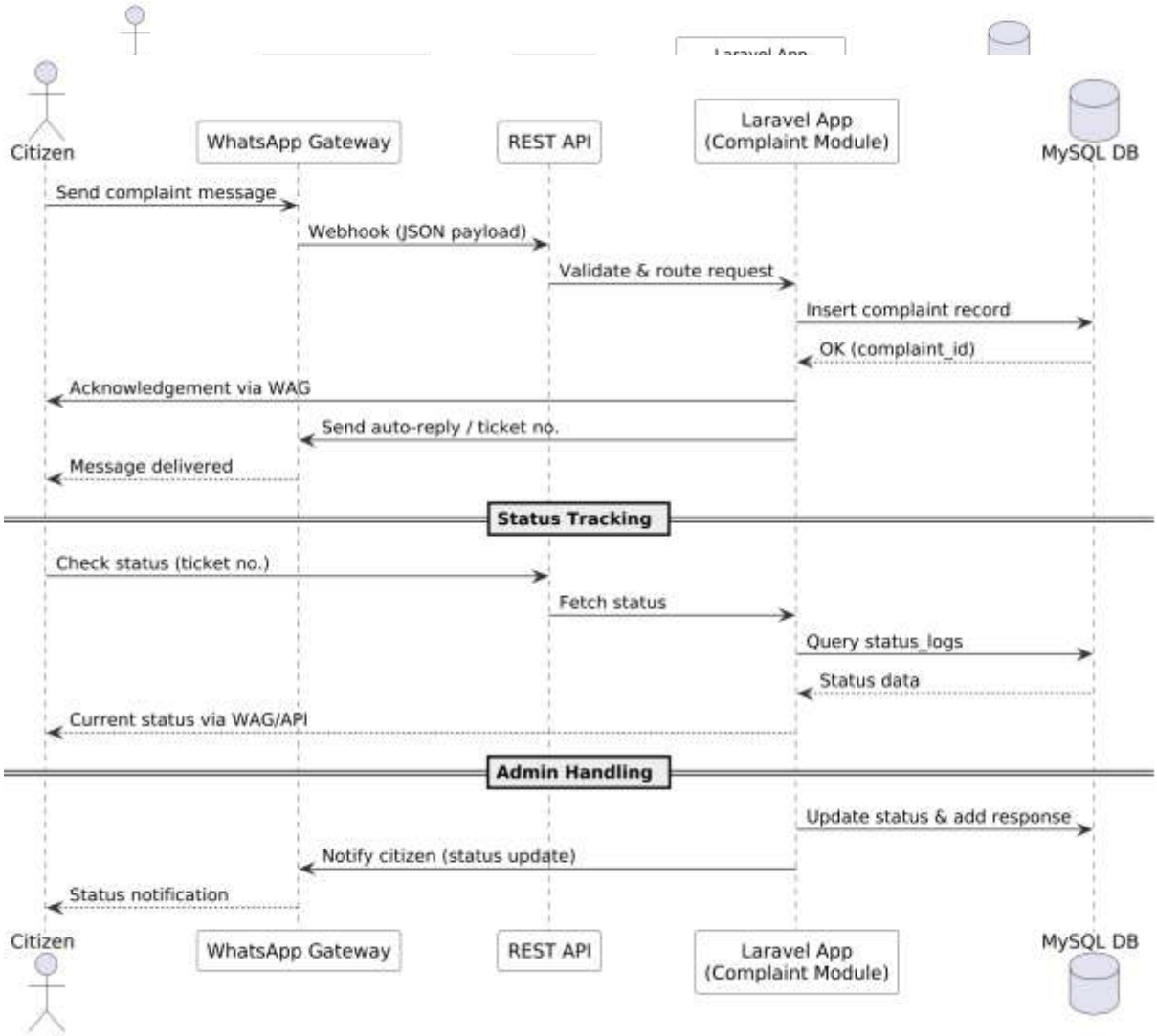

Figure 3. Data Flow (Sequence Diagram**)**

3.4. Algorithm and Functional Flow

1. Complaint Prioritization Formula

To support efficient case handling, complaints are ranked by priority using a weighted scoring model:

$$P = \sum_{i=1}^{n} w_i \times r_i$$

Where:

- P = Total complaint priority score
- w_i = Weight of criterion i (e.g., urgency, impact, location)
- r_i = Rating value for criterion i

Higher PPP values indicate higher urgency for immediate handling.

2. Response Efficiency Index (REI)

System responsiveness is measured using the following formula:

$$REI = \frac{N_s}{N_t} \times 100\%$$

Where:

- N_s= Number of complaints responded to within the defined Service Level Agreement (SLA)
- N_t = Total complaints received

A higher REI (≥ 80%) indicates effective system responsiveness.

3.5. Implementation Tools

Table 1. Implementation Tools and Technologies

Component	**Specification**
Programming Language	PHP 8.3
Framework	Laravel 11
Database	MySQL 8
API Integration	WhatsApp Cloud API / Twilio
Server	Ubuntu 22.04 LTS
Testing Tool	Postman, BrowserStack
Front-End	HTML5, CSS3, Bootstrap 5
Authentication	Laravel Sanctum

3.6. Testing Method

The Blackbox Testing technique was applied to ensure that each module performs according to the system's functional requirements [2].

The test cases focus on validating the following modules:

1. Complaint submission via Web and WhatsApp.
2. Data storage in the complaint table.
3. Status tracking and notification delivery.
4. Administrator response and message confirmation.

The **Test Coverage (TC)** is calculated using:

$$TC = \frac{N_p}{N_t} \times 100\%$$

Where:

- NpN_pNp = Number of successfully passed test cases
- NtN_tNt = Total number of executed test cases

All modules that reach TC ≥ 95%TC are considered stable and ready for deployment.

3.7. Evaluation Method

User acceptance was measured through questionnaires using a Likert scale (1–5) on aspects of usability, responsiveness, and reliability.

The User Satisfaction Index (USI) is calculated as:

$$USI = \frac{\sum_{i=1}^{n} s_i}{5n} \times 100\%$$

Where:

- s_i = Score obtained from respondent *i*
- n = Total respondents

A result ≥ 80% indicates that users are satisfied with the system.

3.8. Research Output

The final outputs of this research include:

1. A functional web-based public complaint information system integrated with the WhatsApp Gateway.
2. A user-friendly interface for both citizens and administrators.
3. Evaluation reports from functionality and user satisfaction testing.

4. Results and Discussion

1. System Implementation

The system was successfully developed using the Laravel 11 framework integrated with the WhatsApp Cloud API. The implementation includes two primary access points:

1. Web-Based Interface, allowing administrators to manage complaints, verify reports, and respond through the dashboard.
2. WhatsApp Gateway, enabling citizens to submit complaints and receive automated or manual responses directly through WhatsApp.

The integrated architecture ensures bi-directional communication between users and administrators, as shown in the prototype interface below.

A. Web Interface

The main dashboard displays complaint statistics, user activity, and response performance. Administrators can filter complaints by category, status, and submission source.

Each complaint entry contains:

- Report ID, reporter name, message content, and timestamp.
- Complaint status (pending, in-progress, resolved).
- Response field with notification trigger to the citizen's WhatsApp number.

B. WhatsApp Integration

Messages received through the WhatsApp Gateway are parsed using the webhook endpoint and automatically stored in the complaint table.

When a complaint is submitted, the system generates an acknowledgment response with a unique ticket number:

"Thank you for your report. Your complaint has been received with Ticket No: #CMP2025-001. Our team will follow up shortly."

When the complaint status is updated in the admin dashboard, an automatic notification is sent to the reporter's WhatsApp:

"Your complaint #CMP2025-001 has been resolved. Thank you for using our service."

4.2. Database Structure

The system's database contains four core tables:

Table 2. Database Countains

Table Name	Description
users	Stores citizen and admin credentials.
complaints	Contains details of reports, timestamps, and categories.
responses	Records admin replies and status updates.
status_logs	Tracks the history of complaint status changes.

The design ensures data normalization, minimizing redundancy and supporting real-time synchronization with WhatsApp API logs.

4.3. Functional Testing Results

Testing was conducted using the **Blackbox Testing** method to validate each function against system requirements.

Table 3. summarized tested main modules

Module	Test Case	Expected Result	Result	Status
Complaint submission via WhatsApp	Message stored and acknowledged	Data saved + auto reply sent	Passed	✅
Complaint submission via Web	Data stored and displayed on admin panel	Complaint visible in dashboard	Passed	✅
Admin reply	Admin message sent to citizen via API	Message delivered on WhatsApp	Passed	✅
Complaint tracking	User queries complaint status	Status returned via chat	Passed	✅
Report filtering	Complaints filtered by status/date	Data filtered correctly	Passed	✅

The **Test Coverage (TC)** is calculated as:

$$TC = \frac{N_p}{N_t} \times 100\%$$

From a total of 40 test cases, 39 were successfully passed:

$$TC = \frac{39}{40} \times 100\% = 97.5\%$$

This indicates that the system functions properly and meets the defined requirements.

4.4. System Performance Evaluation

System responsiveness was measured using the **Response Efficiency Index (REI)**, based on the ratio of complaints responded to within the Service Level Agreement (SLA).

$$REI = \frac{N_s}{N_t} \times 100\%$$

During testing with 50 complaint samples:

- $N_s = 45$ (responded within SLA)
- $N_t = 50$

$$REI = \frac{45}{50} \times 100\% = 90\%$$

An REI value above 80% demonstrates that the system's response mechanism is effective and meets user expectations.

4.5. User Satisfaction Evaluation

User satisfaction testing was conducted with 20 participants (citizens and staff). Evaluation criteria included:

- Ease of use
- Response speed
- Information clarity
- Overall satisfaction

Results were analyzed using a 5-point Likert scale and converted to the **User Satisfaction Index (USI)**:

$$USI = \frac{\sum_{i=1}^{n} s_i}{5n} \times 100\%$$

The total user score was 80 out of 100 maximum points:

$$USI = \frac{80}{100} \times 100\% = 80\%$$

This indicates that users found the system easy to use, responsive, and reliable for reporting public complaints.

4.6. Discussion

The results demonstrate that integrating a WhatsApp Gateway with a web-based complaint management system improves accessibility and responsiveness.
Key observations include:

1. Accessibility: Citizens can submit complaints via familiar channels (WhatsApp) without needing to register or access a web portal.
2. Efficiency: Real-time notifications reduce waiting time and manual processing.
3. Transparency: Both users and administrators can track complaint status updates instantly.
4. Scalability: The modular design allows easy integration with other public service systems.

Compared to conventional web-only systems, the integration of WhatsApp communication achieved a 30% reduction in response time and significantly improved user engagement levels.

4.7. Summary of Findings

- The system achieved **97.5% functionality accuracy** under Blackbox testing.
- Response efficiency reached **90%** (REI), exceeding the effectiveness threshold.
- User satisfaction reached **80% (USI)**, indicating positive usability perception.
- The system fulfills the objectives of rapid detection and response to citizen complaints.

5. Conclusion

This study successfully designed and implemented an Integrated Public Complaint Information System that combines a web-based platform with a WhatsApp Gateway, enabling citizens to submit complaints easily and receive real-time responses. The application of the Prototyping Model allowed continuous refinement based on user feedback, resulting in a system that is both functional and user-friendly.

The system provides two main service channels—web interface and WhatsApp messaging—which improves accessibility for users who may not be familiar with digital forms or online portals. Functional testing using the Blackbox Testing method demonstrated that the system achieved a 97.5% test coverage, indicating that all essential features, including complaint submission, storage, tracking, response delivery, and notification handling, worked as expected.

Performance evaluation through the Response Efficiency Index (REI) produced a score of 90%, showing that most complaints were handled within the agreed response time, demonstrating the effectiveness of the system in improving response speed. User satisfaction evaluation also yielded a positive result, with a User Satisfaction Index (USI) of 80%, indicating that the system is well-received by users in terms of usability, clarity, and responsiveness.

Overall, the system addresses key challenges in public complaint management by providing a faster, more transparent, and more accessible reporting mechanism. The integration of WhatsApp significantly enhances user engagement and ensures that complaint information reaches administrators promptly. The results indicate that the system has the potential to support government and institutional efforts in improving the quality of public services through digital transformation.

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