

SMART DIGITAL PLATFORM FOR RESIDENTIAL COMMUNITY SERVICE

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Abstract

Residential community management is getting really complicated because of how it is growing. This is making it hard to coordinate services be transparent and be efficient. Most residential communities use new ways to manage things. These ways have a lot of problems and do not work very well. They often lead to communication and issues that are not solved. This paper is about creating a digital system to manage residential communities. The system we are talking about will bring together management, complaint management, parking management, digital payment and role-based management all in one place. It will also have a way for residents, tenants, owners, administrators and service providers to interact with each other. The residential community management system we are proposing is based on a cloud-based approach so that it can be managed from one place and can grow if needed. This system is an example of how software can be used to manage residential communities in a better way. Residential community management is what this system is, about. It is designed to make residential community management easier and more efficient. The system is a digital-based residential community management system.

Keywords: Intelligent Communities, AI, NLP, Urban Computing, Problem Solving, and Resident Assistance.

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I. Introduction

With rapid urbanization and population density, there are some inclines in the management of residential & housing societies. Manual record keeping, physical communication and paper processes for maintenance billing are still the norms of traditional society management along with visitor tracking, complaint handling, announcements etc. These widely accepted approaches are slow, error-prone and opaque, leading to delays in delivery of services and communication breakdown between residents and administrators

Digital solutions are proving to be beneficial in enhancing the management quality of residential communities with the evolution of mobile technologies, cloud computing, and web-based platforms. By integrating mobile applications and cloud databases, smart society monitoring systems automate the essential administrative processes like billing management, visitor entry verification, complaint registration and resident communication. They also minimize the manual workload and improve operational efficiency and transparency in housing societies [1]

Complaint management systems have also gained significant attention as an essential component of modern digital governance. Web-based complaint platforms allow citizens or residents to submit issues digitally, attach supporting information such as images or location data, and track

complaint resolution in real time. Such systems improve accountability and communication between users and administrators, enabling faster problem resolution and improved service delivery [2].

Several researchers have proposed web-based complaint registration frameworks that integrate modern technologies such as geolocation services, real-time notifications, and cloud-based data storage to enhance system responsiveness. These platforms simplify complaint submission and enable authorities to manage service requests more efficiently while maintaining accurate digital records of reported issues [3].

In addition to technical implementations, some studies have examined the social and economic factors influencing citizen complaints and participation in public service systems. Understanding user behavior and complaint trends helps authorities improve service quality and design more effective digital governance platforms [4]. Mobile-based governance applications further enhance accessibility by enabling users to report issues directly through smartphones, thereby increasing responsiveness and community participation in service management processes [5].

Research on public complaint platforms has also explored the use of data analytics and digital governance frameworks to analyze large volumes of complaint data. These systems support policy-making and administrative decision-making by identifying common service issues and improving resource allocation strategies [6]. In the same vein, studies on the implementation of e-government have shown that the use of digital complaint mechanisms can greatly improve transparency and satisfaction in the administration and management of public services [7].

In addition, the recent advances in smart city technologies underscore the need to incorporate Artificial Intelligence (AI), automation, and digital transformation in the development and implementation of intelligent urban management systems. For instance, the use of AI in the management and administration of urban areas can help in the analysis and optimization of urban environments, hence promoting sustainable urban management [8]. Studies on the development and implementation of smart urban platforms underscore the need to integrate residential infrastructure and technologies. [9] In addition, the progress made in the study of smart cities shows the importance of digital intelligence in managing communities in a city, thus achieving the objectives of a sustainable community. This involves the integration of various technologies such as automation, AI, etc., to enhance the services offered to the public [10].

Although the literature review has offered useful insights into the digital complaint management system, e-governance, smart city technologies, etc., the current solutions have been designed to cater to particular requirements rather than providing a single system for the management of a residential community. Hence, there is a need for a centralized digital platform to integrate various services related to the management of a society.

1.2 System Overview

Owners, tenants, administrators, residents, and service providers are all included in a single digital environment through the flexible Urban Community Service Hub, which uses AI. The billing, organization of services, and complaint handling of the recommended mobile app are simplified.

A. Essential System Elements

- 1) User Authentication and Access Management- Every type of user, i.e., Admin, Resident, Tenant, Owner, & Service Providers, has different access levels, which are granted through the JWT token
- 2) Complaint & Issue Management- The AI-based system will identify the complaint type through text, image, & voice inputs

- 3) Complaint and Issue Management- The AI-based system identifies the type of complaint through text, image, and voice inputs.
- 4) Payment and Billing- The integration of the Razorpay API allows for the payment of online maintenance fees, as well as the generation of receipts.
- 5) Facility Reservation- Users can book facilities such as the auditorium or the fitness center using a calendar-based system.
- 6) AI Analytics Dashboard: Administrators can view the status of the complaints, services, and even the trends of the issues.

B. Features of the Mobile Application are as follows:

- Support for offline use in areas with poor connectivity.
- Alert system using Firebase Cloud Messaging (FCM).
- Family accounts: sub-users associated with a primary resident account.
- Flow of authorization for repair requests between tenant and owner.
- Consolidated service directory (plumber, electrician, housekeeper) featuring star ratings.

C. Integration of the Backend:

The backend section has included a Flask AI Microservice for text and image analysis, and Node.js Express API for user interaction. MongoDB Atlas, which offers horizontal scalability and redundancy, has been used for the database.

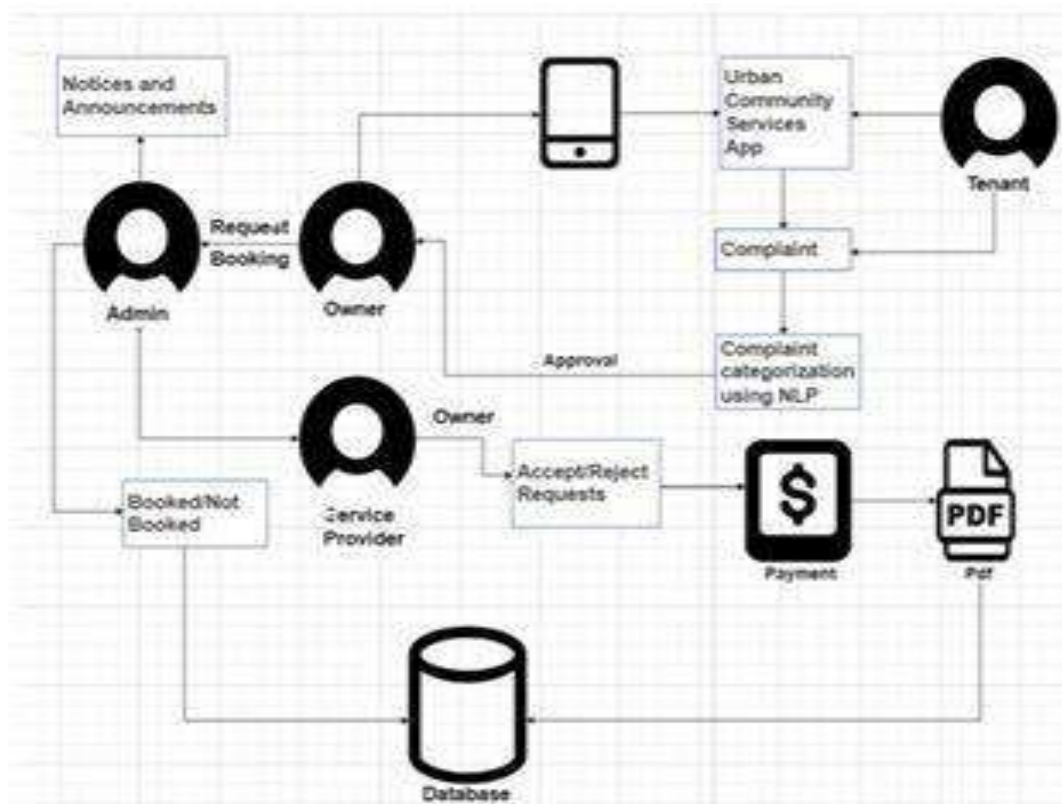


Fig 1. Architecture of the Urban Community Service Hub System

II. Review of Literature

Year	Title	Description	Authors	Gap Identified
2021	AI-Driven Complaint Management System	Proposes an AI-based complaint logging portal that uses sentiment analysis to prioritize citizen grievances and improve communication with government authorities.	Shreyas Shedge, Pratik Wadkar, Atreya Raorane, Bushra Shaikh	Focuses mainly on complaint prioritization using sentiment analysis but lacks advanced analytics, automation features, and large-scale deployment considerations.
2025	Smart Complaint Management System	A web-based complaint platform allowing residents to submit complaints with images and location details while enabling technician assignment and real-time tracking.	Ranjita K. Agasibagila, Keerthana M.S.	Does not include intelligent AI-based complaint analysis or automated prioritization using NLP techniques.
2021	Complaint Registration System Through Web Services	Uses web services with geolocation and real-time notifications to simplify complaint registration and improve communication between citizens and authorities.	D. Venkata Subramanian, K.G.S. Venkatesan, M. Praveena, U. Prasad, N. Narasimha Rao	Lacks advanced prioritization mechanisms and automated decision-making for complaint resolution.
2018	e-Reklamo: An e-Government Portal for Citizens' Complaints Using Web Crawling	Collects complaints from government portals and social media using web crawling and analyzes them using topic modeling.	Shirley D. Moraga, Albert A. Vinluan	Focuses on complaint data aggregation and analysis but does not provide real-time complaint resolution or technician-level management.

2023	Public Services and Citizen Complaints: Economic, Social and Political Determinants of Citizen Complaint	Examines factors influencing citizen complaints and how complaint data can improve public service delivery.	Marianna Sebő, Germà Bel	The study is analytical and theoretical and does not propose a technical implementation for complaint management systems.
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Year	Title	Description	Authors	Gap Identified
2014	Munizapp: Mobile Government Complaint Management System	Introduces a mobile-based platform that allows citizens to report municipal issues using smartphones.	Carl- Mikael Lönn	Does not include automated complaint prioritization or intelligent resource allocation.
2021	From Bulletin Boards: The Origins and Evolution of Public Complaint Websites in China	Studies the evolution of digital complaint platforms and how governments use complaint data for policy decisions.	Christian Göbel, Jie Li	Focuses on governance insights rather than system architecture or technical implementation
2023	A Portrait of E-Government Implementation in Public Complaint Services	Evaluates the impact of e-government complaint systems on transparency and citizen satisfaction.	Arif Wibowo, Dian Novita Lestari	Does not integrate advanced automation features such as AI-based prioritization or chatbot assistance.
2025	Sentiment Analysis Based Complaint Prioritization System	Uses natural language processing techniques to analyze user complaints and determine their urgency.	Yuling Chen et al.	Focuses on sentiment classification accuracy but does not integrate the model into a full complaint management system.
2024	Empowering Smart Cities with AI and RPA: Strategies for Intelligent Urban Management and Sustainable Development	Discusses how Artificial Intelligence and Robotic Process Automation can improve urban governance and automate smart city services.	Kamala Venigandla, Navya Vemuri, Ezekiel Nnamere Aneke	Provides conceptual smart city strategies but lacks a practical implementation for AI-based complaint management systems.

III. Approach and AI Implementation

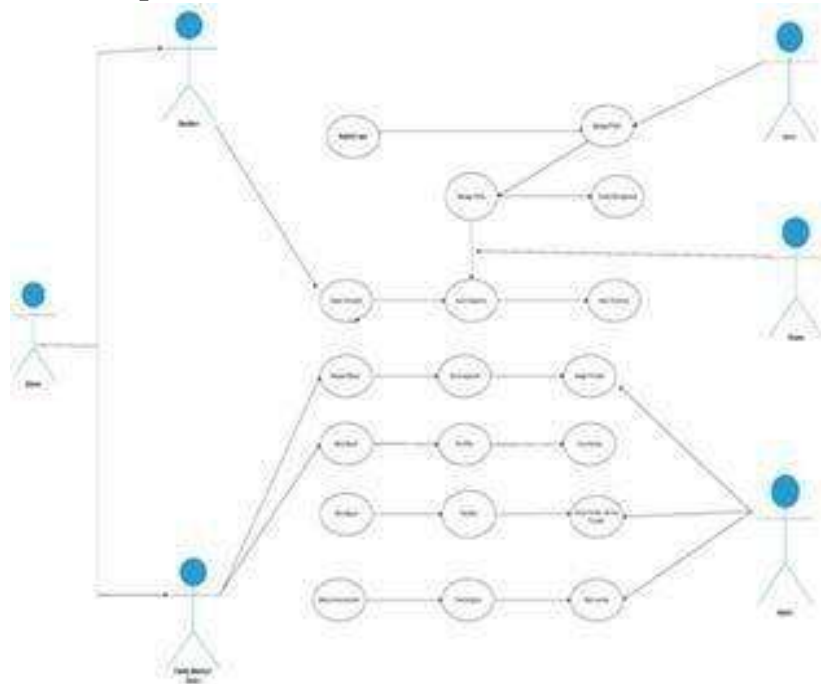


Fig 2. Use Case Diagram

The system's AI layer guarantees automation and smart decision-making.

A. Processing of Natural Language (NLP)-

Complaint texts undergo preprocessing through tokenization, removal of stop words, and lemmatization. MiniLM Transformer model produces sentence embeddings that offer semantic representations for clustering and classification.

B. Pipeline for Machine Learning-

Clustering: K-Means clustering algorithm is used for grouping complaints based on common factors such as water leakage, electrical issues, etc.) Classification: Random Forest designates labels for complaint categories. Anomaly Detection: Isolation Forest identifies unusual complaint trends or repetitions. Sentiment Analysis: TextBlob and spaCy identify tone and feelings in feedback for evaluating service quality

C. Analysis of Images-

OpenCV uses the structural similarity index (SSIM) for analyzing the images that have been uploaded for identifying any physical irregularities, i.e., cracks, leakages, etc. TensorFlow Lite can be run on mobile devices without any cloud support.

D. Summary of AI Workflow-

- Submission from user (text/image/audio)
- Processing and creation of embeddings
- Model prediction (categorization/grouping)
- Storing results in MongoDB
- Alert and display in application dashboard

IV. Application Workflow System

The Urban Community Service Hub, which is based on AI, has a modular and organized approach to ensure smooth interaction between users, the backend, and the AI components.

A) User Engagement Path-

For accessing the mobile application, the user has to safely login using JWT tokens for authenticating the user. Based on the login credentials, the user is categorized as a Resident, Tenant, Owner, Admin, or a Service Provider, and the interface is displayed to the user. Family members are associated with the main resident's account and have restricted access.

B) Flow of Complaints and Services-

Upon submission of a complaint by a resident or tenant (through text, image, or voice), it is directed to the Flask AI microservice. The text classification is handled by the NLP module, whereas the image processing component identifies irregularities or visual flaws employing SSIM and TensorFlow Lite. The admin subsequently allocates the problem to a free service provider. The provider modifies the status once the issue is fixed, and the user gets a confirmation alert.

C) Payment and Notification Process-

The integrated Razorpay SDK allows residents and property owners to process facility or maintenance fees and generates PDF receipts automatically. Every user will receive real-time notifications about announcements, bill due dates, and complaint updates thanks to the Firebase Cloud Messaging (FCM) service.

D) Optimization of Systems and Flow of Data Learning

To improve precision, the system regularly examines resolved complaints and user input utilizing archived datasets

E) General Flow Depiction

The entire procedure can be depicted as a combined Flowchart–Sequence Diagram, illustrating transitions from user input → AI processing → database modification → admin intervention → notification response. This organized data movement boosts clarity, minimizes delays, and guarantees immediate traceability in the society's digital environment

F) Role-Based Control Mechanism, Data Security, and Integrity-

All the activities performed by the application, such as granting the requests, paying, and lodging the complaints, are encrypted using SHA-256 encryption and recorded in the audit log

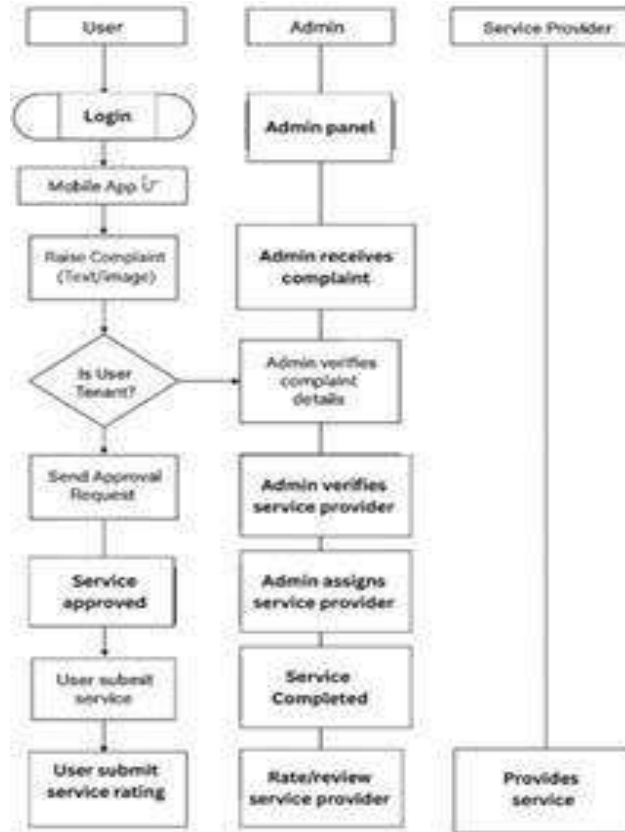


Fig 3. Application Flow Chart

4.1 Viability and Extent:

A) Practical Feasibility-

This interface is made for residential complexes that have between 50 and 500 apartments. These complexes can be found in city settings. Hindi, Marathi, English, etc., have been included

B) Financial Viability-

Some free and open-source technologies that can reduce development costs for building an app are React Native, Node.js, Flask, MongoDB, and Hugging Face models.

C) Timeline for the Project-

Phase	Duration	Key Deliverables
Planning & UI Design	2 weeks	Wireframes, Layout approval
Backend & Database Setup	3 weeks	API endpoints, MongoDB
AI Integration	4 weeks	NLP + Image model testing
Testing & Debugging	3 weeks	User acceptance, bug fixes
Deployment	2 weeks	Final release on Render.com

D) Technical Hazards and Contingency Strategy-

Table 3. Risk Evaluation and Backup Strategy

Risk	Impact	Backup plan
Server Downtime	Delayed responses	Local caching of requests
AI Model Misclassification	Wrong category	Manual admin override
Payment Gateway Failure	User dissatisfaction	Retry mechanism & alerts

V. Test Case Table

A. Authentication and User Management

Test ID	Test Scenario	Input / Steps	Expected Result
TC- AU1	User Registration Validation	Submit registration form with missing fields	System displays validation message requesting required fields
TC- AU2	Invalid Email Format	Enter email with incorrect format	Email validation error is displayed
TC- AU3	Password Strength Check	Enter password with fewer than 8 characters	System rejects password and prompts for stronger credentials
TC- AU4	OTP Verification	Enter valid OTP during registration	User account is successfully created and redirected to dashboard
TC- AU5	Session Persistence	Login and restart the application	User session remains active and dashboard loads automatically

B. Complaint Management Module (AI-Assisted)

Test ID	Test Scenario	Input / Steps	Expected Result
TC- AU1	User Registration Validation	Submit registration form with missing fields	System displays validation message requesting required fields
TC- AU2	Invalid Email Format	Enter email with incorrect format	Email validation error is displayed
TC- AU3	Password Strength Check	Enter password with fewer than 8 characters	System rejects password and prompts for stronger credentials
TC- AU4	OTP Verification	Enter valid OTP during registration	User account is successfully created and redirected to dashboard

TC- AU5	Session Persistence	Login and restart the application	User session remains active and dashboard loads automatically
TC- CM 3	Priority Detection	Enter description indicating urgent issue	System assigns higher priority level
TC- CM 4	Complaint Filtering	Apply status filter (Pending / Resolved)	Only complaints matching the selected status are displayed
TC- CM 5	Complaint Detail View	Select complaint from list	Detailed complaint timeline and status are displayed

C. Facility Booking Module

Test ID	Test Scenario	Input / Steps	Expected Result
TC- FB1	Facility List Display	Open facility booking module	Available facilities are displayed
TC- FB2	Date and Slot Selection	Select facility, date, and time slot	Selected slot is highlighted and booking option enabled
TC- FB3	Booking Validation	Attempt booking without selecting slot	System prompts user to select facility and time
TC- FB4	Booking Confirmation	Confirm booking for selected slot	Booking confirmation message displayed

D. Bill Payment Module

Test ID	Test Scenario	Input / Steps	Expected Result
TC- BP1	Bill Display	Open billing module	All pending bills are listed with due dates
TC- BP2	Individual Bill Payment	Select and pay a specific bill	Payment success confirmation
TC- BP3	Pay All Bills	Select 'Pay All' option	System processes payment for all pending bills
TC- BP4	Payment History	Navigate to history tab	Previous transactions are displayed and transaction ID displayed

E. Admin Complaint Management

Test ID	Test Scenario	Input / Steps	Expected Result
TC- AD1	Complaint Monitoring	Admin opens complaint dashboard	System displays complaint statistics and priority alerts
TC- AD2	Complaint Assignment	Admin assigns complaint to service provider	Complaint status changes to 'Assigned'
TC- AD3	Complaint Resolution	Admin marks complaint as resolved	Complaint status updates to 'Resolved'

F. Complete System Integration

Test ID	Test Scenario	Input / Steps	Expected Result
TC- INT1	Complaint Lifecycle	Resident raises complaint → Admin views	Complaint appears in admin dashboard
TC- INT2	Provider Workflow	Admin assigns complaint to provider	Provider receives job notification
TC- INT3	Service Completion	Provider marks task complete	Complaint status updated to resolved for resident
TC- INT4	Notice Broadcast	Admin posts notice	Notice becomes visible to all residents

VI. Advantages and Disadvantages

A) Advantages-

- [1] Complaint classification using AI minimizes human mistakes.
- [2] Image anomaly detection guarantees the validity of problems.
- [3] Instant alerts enhance transparency.
- [4] Covers various positions: Resident, Administrator, Owner, Tenant, and Service Provider.
- [5] Complaint registration offline for areas with weak network coverage.
- [6] Modular, scalable structure appropriate for future smart city incorporation.
- [7] Cost savings on projects are achieved through free AI tools.

B) Constraints-

- [1]The quality of the dataset determines accuracy.
- [2]Demands moderate device processing for AI on the device.
- [3]A foundational training phase is required.
- [4]Voice input restricted to English and Hindi models.
- [5]Cloud-free mode limits the use of large models.

VII. Conclusion and Future Work

The Urban Community Service Hub, supported by AI, blends traditional complaint handling with intelligent automation.

The combination of NLP, computer vision, and sentiment analysis offers comprehensive oversight of societal functions. Upcoming enhancements consist of:

- Immutability of records based on blockchain technology.
- Decentralized AI for secure learning while maintaining privacy.
- Integration of chatbots for immediate user assistance.
- Predictive analysis to anticipate ongoing problems.
- Incorporation of IoT sensors for automatic identification of faults.

References

1. Shreyas Shedge, Pratik Wadkar, Atreya Raorane, and Bushra Shaikh, "AI-Driven Complaint Management System," Department of Information Technology, SIES Graduate School of Technology, Navi Mumbai, India.
2. Ranjita K. Agasibagila and Keerthana M. S., "Smart Complaint Management System," *International Journal of Progressive Research in Engineering Management and Science (IJPREAMS)*, vol. 5, no. 12, pp. 982–987, Dec. 2025.
3. D. Venkata Subramanian, K. G. S. Venkatesan, M. Praveena, U. Prasad, and N. Narasimha Rao, "Complaint Registration System Through Web Services," *International Journal of Computational Intelligence in Control*, Dec. 2021.
4. Shirley D. Moraga and Albert A. Vinluan, "An e- Government Portal for Citizens' Complaints in Government Services Using Web Crawling," *Asia Pacific Journal of Multidisciplinary Research*, Nov. 2018.
5. Marianna Sebő and Germà Bel, "Public Services and Citizen Complaints: Economic, Social, and Political Determinants of Citizen Complaints," *International Public Management Journal*, 2023.
6. Christian Göbel and Jie Li, "From Bulletin Boards: The Origins and Evolution of Public Complaint Websites in China," *Journal of Current Chinese Affairs*, 2021.
7. Arif Wibowo and Dian Novita Lestari, "A Portrait of E- Government Implementation in Public Complaint Services," *Journal of Public Administration Studies*, 2023.
8. Kamala Venigandla, Navya Vemuri, and Ezekiel Nnamere Aneke, "Empowering Smart Cities with AI and RPA: Strategies for Intelligent Urban Management and Sustainable Development," *International Journal of Scientific Research and Management (IJSRM)*, vol. 12, no. 04, Apr. 2024.
9. Amy J. C. Trappey, Charles V. Trappey, and others, "Intelligent Complaint Handling and Decision Support Systems for Customer Service Management," *International Journal of Production Economics*, 2019.
10. Yuling Chen, Zhiqiang Zhang, and others, "Sentiment Analysis for Internet Reviews Based on Machine Learning Techniques," *Applied Sciences*, vol. 15, 2025.