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AI-Driven Smart City Grievance Management and Automated Complaint Escalation System

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Abstract: This paper presents a comprehensive and intelligent Smart city Grievance Management System aimed at transforming the traditional complainthandling process into an automated, efficient, and transparent workflow. The system integrates advanced technologies such as Natural language processing (NLP), Machine Learning -based classification, Cosine similarity-based duplicate detection, and service level Agreement (SLA) driven escalation mechanism. Citizens can register complaints related to civic issues including road damage, drainage blockage, water leakage, streetlight failures, and sanitation concerns. The proposed system automatically categorizes complaints, assign priorities, detects duplicates, and forwardthem to appropriate departments. Experiment evaluation demonstrates improved efficiency, reduced redundancy, and enhanced citizen satisfaction.

Keywords: Smart City Governance, Grievance Redressal, Natural Language Processing, Duplicate Detection, SLA Escalation, Priority Prediction, Civic Automation.

I. INTRODUCTION

In today's digital era, effective complaint management is essential for improving public services such as water supply, electricity and infrastructure maintenance. However, many existing systems still rely on manual or semi-automated processes, which lead to delays, insufficient handling and lack of proper communication between departments. These limitations reduce the overall quality of service and affect user satisfaction.

Another major challenge in traditional systems is the absence of intelligent processing. Complaints are not automatically categorized or prioritized, making it difficult to identify urgent issues. In addition, duplicate complaints often increase the workload unnecessarily, and there is limited transparency for users to track the status of their complaints in real time.

To overcome these issues, COMPLAINEX introduces an AI-driven complaint management system that automates classification, priority assignment and routing. By integrating NLP, duplicate detection and SLA-based monitoring the system ensures efficient handling of complaints while improving transparency and accountability. It also supports predictive analytics to assist administrators in better decision-making.

II. LITERATURE REVIEW

Recent advancements in artificial intelligence and smart governance have significantly improved the efficiency of complaint handling system across multiple domains. Existing research has demonstrated the effectiveness of natural language processing (NLP) and machine learning techniques in automatically identifying complaint-related text, classifying severity levels, and routing issues to the relevant departments. A notable study on complaint and severity identification in online financial content highlighted how AI-driven complaint detection models can improve transparency, accountability, and faster issue redressal by combining complaint classification with severity analysis. Several previous grievance management systems primarily focused on complaint registration and manual ticket forwarding. Although these systems provide digital access for users, they often lack intelligent automation features such as semantic duplicate detection, urgency prediction, and deadline-based escalation. Recent machine learning approaches introduce text classification methods using TF-IDF, transformer-based models, and sentiment-aware multitask learning for better complaint understanding.

Handling noisy textual data, especially from user-generated platforms, by accurately separating complaint and non-complaint instances.

In the context of smart city governance, similar AI-driven strategies can be adapted to municipal grievance systems where citizens report civic issues such as potholes, drainage blockage, water leakage, sanitation failures, and streetlight faults. However, most existing smart city portals still fail to integrate duplicate complaint suppression, automated service level agreement (SLA) escalation, and officer accountability dashboards within a single platform. This limitation creates delays in issue resolution and reduces public trust.

The proposed research addresses these gaps by combining NLP-based complaint categorization, severity-aware priority prediction, cosine similarity- based duplicate detection, and SLA-driven escalation workflows into unified grievance redressal framework compared to traditional complaint portals, this integrated approach enhances response speed, transparency, and municipal service efficiency while maintaining scalability for large urban environments.

III. METHODOLOGY

The COMPLAINEX system follows a structured process to handle complaints efficiently. User submit complaints through a web interface by providing necessary details such as title, description, location and image. Once submitted, the system processes the complaint using AI techniques.

The complaint text is analyzed using NLP to identify its category, and duplicate detection is performed using TF-IDF and cosine similarity. Based on the analysis, the system assigns a priority level and routes the complaint to the appropriate department automatically.

The system then monitors the complaint using SLA rules, officers update the status after processing, and if the complaint is not resolved within the deadline, escalation is triggered to higher authorities. This ensures timely resolution and continuous tracking.

IV. PROPOSED SOLUTION

The COMPLAINEX system introduces several improvements over traditional system by integrating automation and intelligence.

- 1) Automatic NLP classification: complaints are analyzed and categorized automatically, reducing manual effort and improving accuracy.
- 2) Duplicate detection: the system identifies similar complaints using cosine similarity, avoiding redundant entries and improving efficiency.
- 3) Auto routing: complaints are directed to the correct department based on the category and location without manual intervention.
- 4) SLA based escalation: Each complaint is assigned a deadline and unresolved cases are escalated automatically to ensure accountability.
- 5) Predictive analytics: the system analyzes complaint data to identify patterns and support better administrative decisions.

V. SYSTEM ARCHITECTURE

- 1) Presentation layer: these layers provide the user interface using HTML, CSS and java script. It allows user to submit complaints and track status, while officers and admins access dashboards for management.
- 2) Application layer: implemented using python flask, this layer handle business logic, authentication, complaint processing and AI operations such as classification and duplicate detection.
- 3) Data layer :MongoDB is used to store data, complaints, status updates and logs. It supports scalable and flexible data management for large datasets.

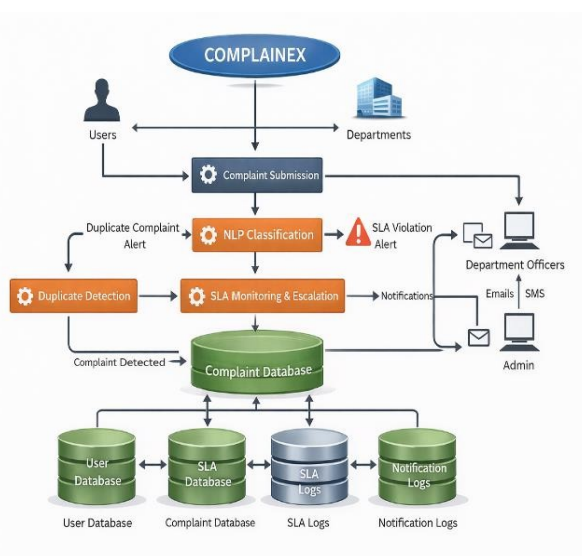


Fig1. System Architecture

VI. MODULE-WISE IMPLEMENTATION

- 1) Authentication module: this module ensure secure access to the system through role-based login for users, officers and administrators.it managesregistration, login validation and session control by restricting access based on roles, it ensures data security and prevents unauthorized operations within the system.

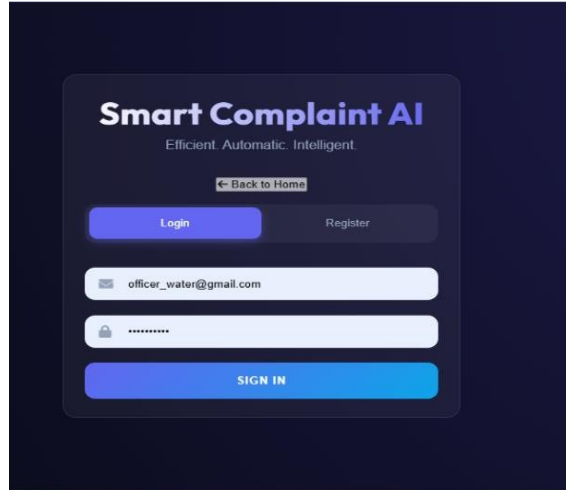


Fig2.Login

- 2) Complaint Management Module: the complaint management module handles the complete lifecycle of complaints from submission to resolution. Users can submit complaints with relevant details, and officers can view, processand update their status. The system maintains structured records for each complaint, ensuring proper tracking and transparency.

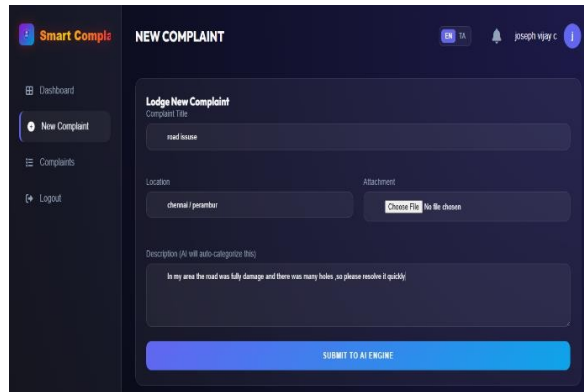


Fig3.Complaint Management

- 3) AI Analysis module: thismodule performs intelligent processing of complaints using NLP techniques. It classifies complaints into categories and assign priorities based on severity. Additionally,itusescosinesimilaritytodetectduplicate complaints, reducing redundancy andimproving system efficiency.



Fig4.AIAnalysis

- 4) Notification module: the notification module manages communication between users and authorities. It sends real-time alerts and email notifications for complaint submission, status updates and escalation events. This ensures that all stakeholders remain informed throughout the process.

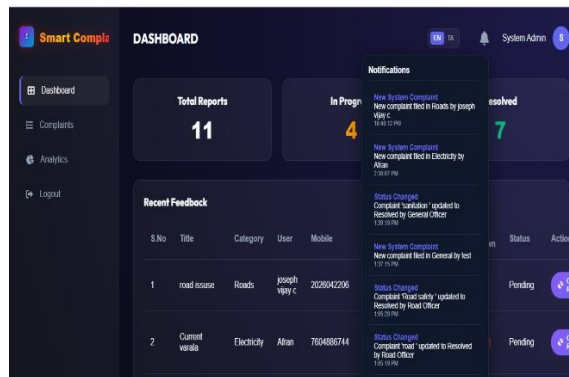


Fig5.Notification

- 5) SLA Monitoring Module: this module tracks the resolution time of complaints based on assigned priorities. It continuously monitors deadlines and triggers escalation when complaints are not resolved on time. This improves accountability and ensures timely action by responsible authorities.

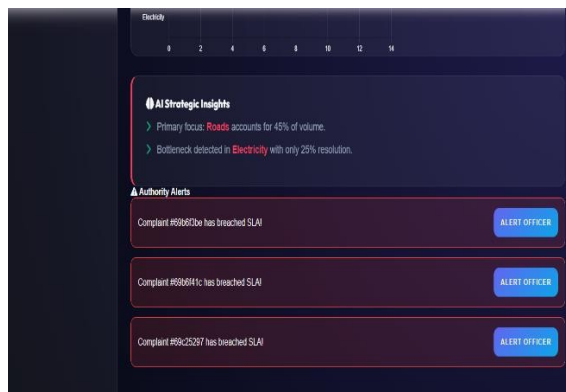


Fig6.SLA Monitoring

VII. ALGORITHMS USED

The system uses natural languages processing(NLP) to analyze complaint text and classify it into appropriate categories. This reduces manual effort and ensures accurate categorization.

TF-IDF is used to convert text into numerical form, capturing the importance of words in the complaint data. Cosine similarity is then applied to measure similarity between complaints, enabling effective detection of duplicates.

The SLA-based algorithm assigns deadlines based on complaint priority levels. It ensures that critical issues are addressed quickly and triggered escalation when deadlines are exceeded.

VIII. RESULTS AND PERFORMANCE ANALYSIS

The COMPLAINEX system was evaluated using Sample complaint data to analyze its performance. The results show that the system effectively automates complaint classification and reduces manual workload. Duplicate detection minimizes redundant entries, while SLA-based monitoring ensures timely resolution. The system improves response time, enhances transparency and provides better resource management compared to traditional systems.

IX. CONCLUSION

COMPLAINEX presents an efficient and intelligent approach to complaint management by integrating AI and automation. The system improves the overall process by automating classification, detecting duplicates and ensuring timely resolution through SLA mechanisms.



It enhances transparency and accountability while reducing manual effort. This makes it a suitable solution for modern governance systems and smart city applications.

X. FUTURE ENHANCEMENTS

The system can be further enhanced by developing mobile applications for better accessibility. Integration of chatbot interfaces can simplify complaint submission. Advanced AI techniques such as sentiment analysis can improve understanding of complaints. Additionally, incorporating GIS mapping and IOT integration can provide more advanced features and improve system efficiency.

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