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

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Abstract: ***Thispaperpresentsacomprehensiveand 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 isessential 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 leadtodelays, insufficient handlingandlack ofproper 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,andthereislimitedtransparencyforuserstrackthestatusoftheircomplaintsinreal time.

To overcome these issues, COMPLAINEX introduces an AI-driven complaint managementsystem that automates classification, priority assignment androuting. Byintegrating NLP, duplicate detection and SLA-based monitoring the system ensures efficient handling of complaints while improving transparency and accountability. It also supportspredictive analytics toassist administratorsin 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 identifyingcomplaint-relatedtext,classifying severity levels, and routing issues to the relevant departmentsA notable study on complaint and severity identification in online financialcontent highlighted how Ai-driven complaint detection models can improve transparency ,accountability, and faster issue redressal by combiningcomplaint classification with severity analysis Several previous grievance management systems primarily focused on complaint registration andmanualticket forwarding.Although these systems provide digital access for users, theyoften lack intelligent automation features such as semantic duplicate detection, urgency prediction, and deadline-based escalation. Recent machine learning approaches introducetext classification methods using TF-IDF, transformer- base models, and sentiment- aware multitask learning for better complaint understanding.

Handlingnoisytextual data, especiallyfrom 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.

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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, locationand image. Once submitted, the system processes the compliant 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 assignsa prioritylevel 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 id not resolved within the deadline, escalation is triggered to higher authorities. This ensures timely resolution and continuoustracking.

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) Duplicatedetection:thesystemidentifies similar complaintsusingcosinesimilarity,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) SLAbasedescalation: Each complaintisassigned 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.

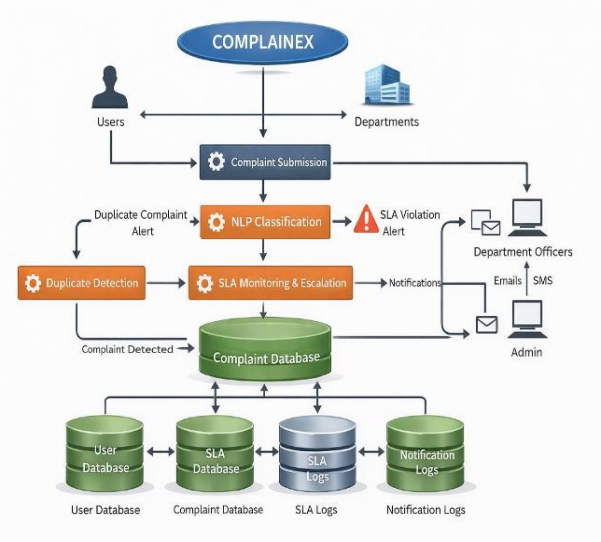


Fig1.SystemArchitecture

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.

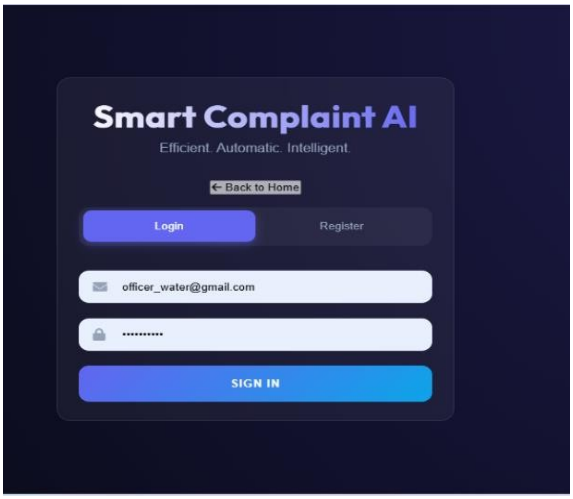


Fig2.Login

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.

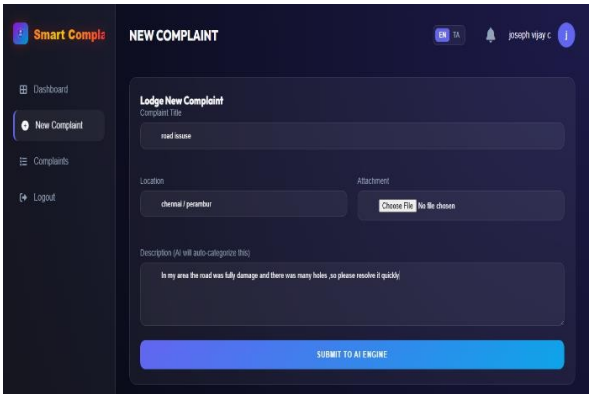


Fig3.Complaint Management

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 thatall stakeholders remain informed throughout the process.

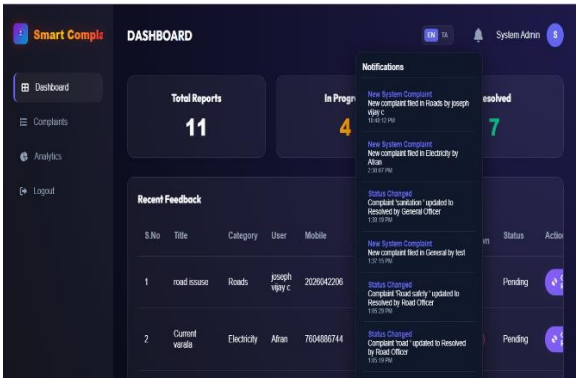


Fig5.Notification

5) SLA Monitoring Module: this moduletracks 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.

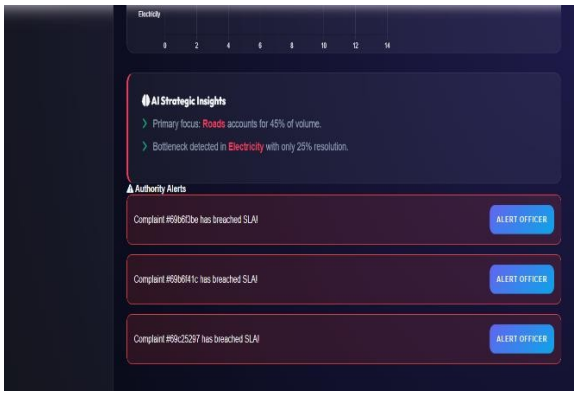


Fig6.SLA Monitoring

VII. ALGORITHMS USED

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

TF-IDF is used to convert text into numericalform, 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 toanalyze its performance.The results show that the system effectively automates complaintclassificationandreducesmanualworkload. Duplicate detectionminimizesredundant entries,while SLA-based monitoring ensures timely resolution. The system improves response time, enhancestransparencyand providesbetterresourcemanagement compared to traditional systems.

IX. CONCLUSION

COMPLAINEX presents an efficient andintelligent 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.

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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 bydeveloping mobileapplicationsfor better accessibility. Integration of chatbot interfaces can simplify complaint submission. Advanced AI techniques such as sentiments analysis can improve understanding of complaints. Additionally, incorporating GIS mapping and IOT integration can provide more advanced featuresandimprovesystemefficiency.

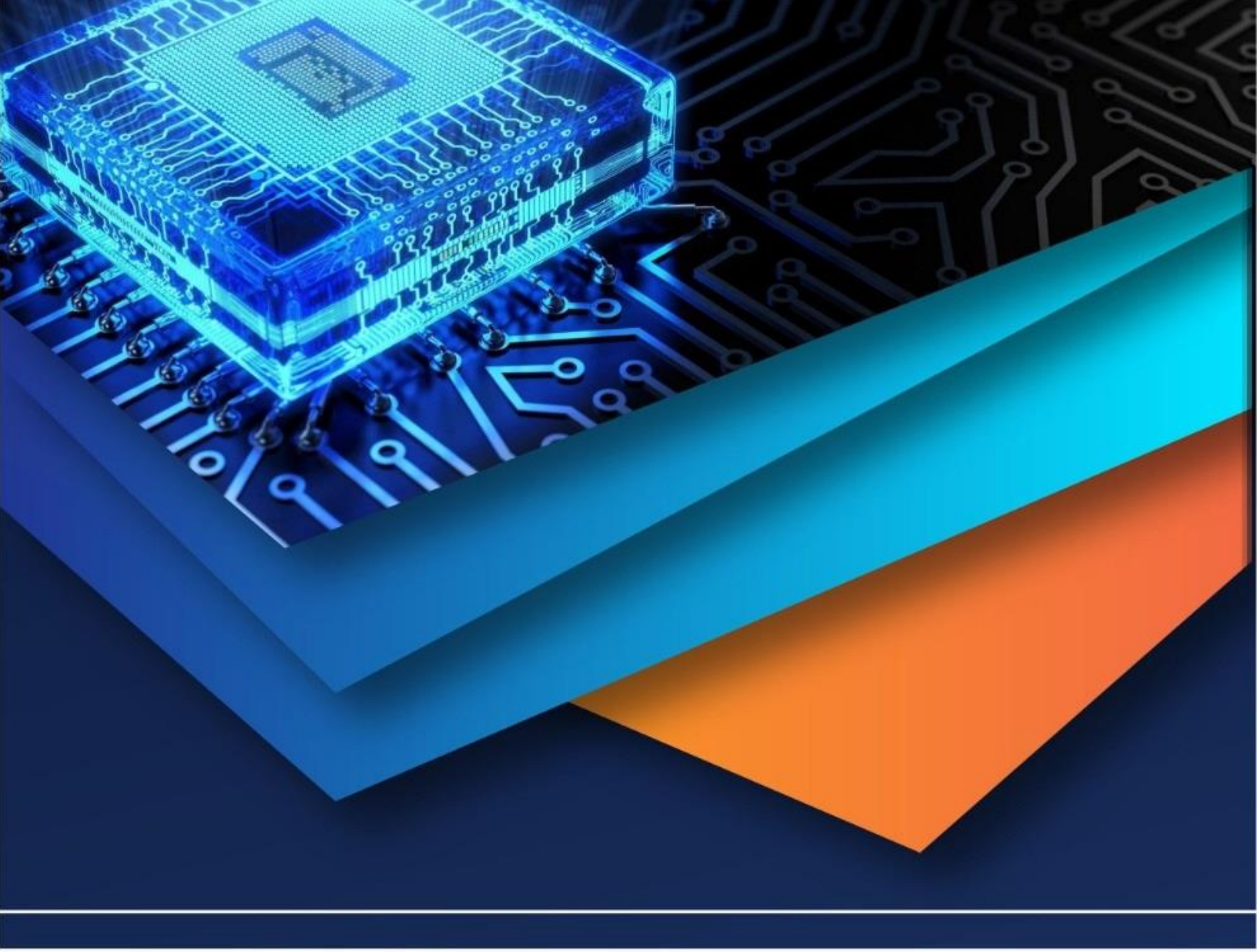
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