

Smart AI-Driven Governance System: AI-Based Multilingual and Intelligent Citizen Grievance Management: A Review

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Abstract- Public administrative grievance portals across developing and developed nations remain severely strained by high filing volumes, multilingual heterogeneity, unstructured text submissions, and manual departmental routing. This paper presents a structured narrative review of 22 verified sources published between 2018 and 2026, including state-of-the-art public sector deployable models, organized into seven themes: administrative grievance dynamics and digital governance barriers; multilingual natural language processing (NLP) and dialect translation; automated department routing and multi-label text classification; sentiment analysis, priority ranking, and urgency detection; Optical Character Recognition (OCR) for hand-written citizen petitions; generative AI and Large Language Model (LLM) decision support; and privacy-preserving edge deployment and ethical AI governance. Large Language Models, Fine-tuned Transformer architectures (mBERT, XLM-RoBERTa, IndicBERT), and hybrid classifier ensembles achieve over 92% precision in routing accuracy and priority score allocation. However, literature evidence is dominated by single-jurisdiction pilots, synthetic datasets, and fair-weather operational conditions, while cross-lingual dialectical shifts, low-resource language processing, systemic bias in priority scoring, and data privacy remain under-reported. The paper contributes a comprehensive thematic synthesis, a comparative breakdown of fourteen representative studies, a proposed conceptual seven-layer governance architecture, and a prioritized research agenda for trustworthy public sector AI integration.

Keywords— Digital Governance; Public Grievance Management; Multilingual Natural Language Processing; Large Language Models; Multi-label Text Classification; Priority Scoring; Responsible AI

I. INTRODUCTION

Citizen grievance management constitutes a critical feedback loop between the public and democratic institutions. Public administration portals, such as CPGRAMS in India, handling over two million grievances annually, face overwhelming bottlenecks due to manual indexing, improper departmental allocation, dialectical language barriers, and incomplete documentation [1]. Traditional e-governance infrastructure relies on static rule-based taxonomy trees, requiring citizens to identify the correct department, administrative tier, and service category prior to lodging a complaint. Consequently, misrouted petitions suffer from multi-week transfer delays, high processing backlogs, and elevated citizen dissatisfaction [2].

The administrative challenge is further intensified in multilingual and linguistically diverse federal states, where citizens submit grievances in regional vernaculars, non-standard scripts, or code-mixed dialects, while administrative personnel operate primarily in national or official languages [3]. Furthermore, manual grievance processing lacks objective mechanisms to detect emergency petitions, such as acute water pollution, public safety hazards, or medical infrastructure breakdowns, treating high-urgency cases with the same queue priority as routine inquiries [4]. Automated AI-driven processing offers transformative potential to streamline classification, translate vernacular input, assess priority, and suggest actionable responses, thereby reducing operational overhead and turnaround times [5].

This paper provides a systematic literature review designed to: (i) synthesise state-of-the-art NLP, OCR, and machine learning techniques applied to public grievance management, (ii) critically compare methodologies, classification accuracies, and operational constraints across representative studies, (iii) propose a literature-grounded conceptual seven-layer governance system architecture, and (iv) define key open research challenges that must be addressed prior to scale-out deployment in public administrative frameworks.

II. R METHODOLOGY

A systematic search across major academic publisher repositories (IEEE Xplore, ACM Digital Library, SpringerLink, Elsevier ScienceDirect, MDPI, and Taylor & Francis), DOAJ, and open-access preprint archives (arXiv) was conducted using combined search queries including: "citizen grievance management", "smart governance AI", "multilingual text classification", "XLM-RoBERTa grievance", "CPGRAMS automated routing", "handwritten petition OCR", "grievance urgency priority scoring", and "responsible AI in public administration".

Peer-reviewed journal articles, conference proceedings, and validated institutional reports published between 2018 and 2026 were prioritized to capture recent breakthroughs in Transformer architectures and Large Language Models. Inclusion criteria specified that studies must directly focus on municipal, national, or regional public grievance platforms, multilingual administrative text analysis, or operational decision-support systems. Theoretical NLP papers lacking public sector contextualization or unverified commercial white papers were excluded. Each included source was verified against DOI databases and institutional records.

III. LITERATURE REVIEW

1. Administrative Grievance Dynamics and Digital Governance Barriers

Sharma et al. reviewed public administration frameworks across regional electronic governance platforms, identifying manual triaging as the primary structural bottleneck in grievance redressal

workflows [1]. They highlighted that over 34% of citizen petitions are initially misallocated due to ambiguous citizen descriptions or complex jurisdictional overlaps between local municipal bodies and state departments. Kumar and Singh evaluated administrative response latencies in centralized government portals, concluding that static rule-based routing engines fail when encountering unstructured or colloquial citizen submissions [2].

Behavioral studies by Patel et al. revealed that citizens, particularly in rural or digitally underprivileged demographics, frequently abandon online portals due to rigid drop-down classifications and non-intuitive language options [4]. Furthermore, Al-Raisi et al. emphasized that public trust deteriorates rapidly when urgent infrastructure or safety complaints remain unaddressed due to static, FIFO (first-in, first-out) queuing models [3].

2. Multilingual Natural Language Processing and Dialect Translation

To address language diversity, Gupta and Joshi explored cross-lingual representation models for Indian vernacular languages, comparing multilingual BERT (mBERT), IndicBERT, and XLM-RoBERTa across 50,000 regional public complaints [6]. Their findings established that XLM-RoBERTa achieved a top F1 - score of 0.93 for multi-class departmental classification, significantly outperforming traditional statistical TF-IDF vectorizers combined with Naïve Bayes or SVM classifiers.

3. Automated Department Routing and Multi-Label Text Classification

Recent research has increasingly reframed grievance handling as a multi-label classification problem, acknowledging that a single citizen petition (e.g., sewage overflow causing road degradation and public health risks) spans multiple administrative authorities. Verstraete and Silva developed a hierarchical neural network architecture that parses unstructured citizen petitions into primary and secondary departmental categories, achieving 94.2% precision across 12 municipal divisions [7].

Similarly, Chen et al. deployed an ensemble model combining lightweight MobileBERT with gradient-boosted decision trees (XGBoost) on edge hardware, enabling real-time routing on low-cost server nodes in local municipal offices [8]. In a recent 2026 study, Reddy et al. demonstrated that integrating zero-shot learning prompts with domain-tuned Large Language Models allows the governance system to correctly categorize emerging grievance categories (such as cyber-fraud or EV charging station defects) without requiring extensive historical training data [9]. Across these studies, recall for minority classes (infrequent complaint types) remains significantly lower than precision for majority categories.

4. Sentiment Analysis, Priority Ranking, and Urgency Detection

Beyond categorisation, automated assessment of petition severity is essential for effective queue management. Zhang et al. incorporated aspect-based sentiment analysis with BERT embeddings to assign urgency scores to citizen complaints, successfully isolating critical public health threats from routine enquiries [10]. Malhotra et al. proposed a dynamic multi-criteria priority matrix incorporating population density, citizen sentiment intensity, and temporal decay, demonstrating a 42% reduction in resolution latency for emergency infrastructure issues [11].

5. Optical Character Recognition (OCR) for Handwritten Petitions

In many developing jurisdictions, a significant proportion of grievances continue to be submitted as scanned physical letters or handwritten documents. Fernandez et al. applied Vision Transformers (ViT) combined with specialized vernacular OCR models to digitize handwritten administrative petitions in regional scripts, achieving a character error rate (CER) below 4.8% on standard administrative document datasets [13].

6. Generative AI and LLM Decision Support for Administrative Officials

Generative models offer promising capabilities in drafting initial response templates and summarizing lengthy historical grievance threads. Khan et al. demonstrated that fine-tuning open-weights LLMs

(such as LLaMA-3 and Mistral) on historical public sector response repositories reduced officer drafting time by 65% while maintaining compliance with statutory administrative formats [14]. Meanwhile, Zhao and Wang investigated Retrieval-Augmented Generation (RAG) frameworks to ground AI-generated responses in official policy documentation, preventing hallucinatory statements regarding public entitlements [15].

7. Privacy-Preserving Edge Deployment and Ethical AI Governance

Public sector deployment necessitates rigorous data protection, fairness, and accountability. Environmental and legal constraints are highlighted by Sivasankar et al., who audited public sector ML models for demographic and geographic bias, revealing that complaints from lower-income zip codes were systematically assigned lower priority scores due to historical training bias [19]. To preserve citizen privacy, Takahashi et al. evaluated federated learning and local differential privacy protocols, allowing municipality-level AI engines to collaboratively train routing models without exchanging raw personal identifiable information (PII) [22].

8. Literature Synthesis

Three primary trends emerge from the literature: (1) Transition from static rule-based taxonomy trees to Transformer-driven deep learning and LLM zero-shot classification; (2) Increasing emphasis on multi-modal integration combining text, speech-to-text, and document OCR; and (3) A critical disconnect between high experimental classification metrics and real-world administrative deployment, where data privacy, algorithmic accountability, and system latency remain substantial barriers.

IV. COMPARATIVE ANALYSIS

Table 1. Comparison of representative intelligent citizen grievance management and smart governance studies.

Author, year	Objective	Method / Technology	Major Reported Findings	Limitations
Sharma et al., 2020 [1]	Public grievance bottleneck evaluation	Empirical workflow analysis & survey	Identified 34% misclassification rate in manual triaging	Qualitative focus; limited technical modeling
Kumar & Singh, 2021 [2]	Static rule-based routing analysis	Pattern matching & decision tree baseline	Fails on colloquial or unstructured text (Accuracy <58%)	High vulnerability to syntax variations
Gupta & Joshi, 2022 [6]	Multilingual vernacular complaint classification	IndicBERT, mBERT, XLM-RoBERTa	XLM-RoBERTa achieved F1 =0.93 across 50k regional petitions	High computational footprint for local server nodes
Verstraete & Silva, 2022 [7]	Multi-label municipal department routing	Hierarchical Neural Network (HNN)	Precision 94.2% across 12 distinct municipal divisions	Requires large labeled training corpus per category
Zhang et al., 2023 [10]	Grievance urgency detection & priority ranking	Aspect-Based Sentiment Analysis + BERT	Successfully isolated health/safety hazards with 91 .5% recall	Struggles with sarcastic or passive language
Chen et al., 2023 [8]	Edge-based low-latency grievance triaging	MobileBERT + XGBoost ensemble	Latency <120ms per petition on budget edge servers	Lower accuracy on code-mixed regional text
Fernandez et al., 2024 [13]	Digitization of handwritten public petitions	Vision Transformer (ViT) + Vernacular OCR	Character Error Rate (CER) reduced to 4.8% on scanned scripts	Performance drops on poorly lit or damaged scans
Malhotra et al., 2024 [11]	Dynamic queue priority optimization	Multi-criteria priority matrix & decay models	42% reduction in emergency resolution latency	Weight parameters require manual administrative tuning
Khan et al., 2025 [14]	Automated official response generation	Fine-tuned LLaMA-3 / Mistral (RAG)	Officer drafting time reduced by 65%	Requires strict human-in-the-loop audit for hallucination
Sivasankar et al., 2025 [19]	Algorithmic bias audit in public sector AI	Fairness metrics & demographic parity audit	Revealed systemic priority score bias against lower-income areas	Focused on single municipal jurisdiction
Reddy et al., 2026 [9]	Zero-shot routing for emergent complaint types	LLM zero-shot learning + Prompt Engineering	Categorized novel complaint types with 88.4% accuracy	Higher API costs and latency per inference
Takahashi et al., 2026 [22]	Privacy-preserving cross-municipal AI	Federated Learning + Differential Privacy	Collaborative model training without sharing citizen PII	5-8% accuracy trade-off for privacy budget

V. PROPOSED CONCEPTUAL ARCHITECTURE

to operate seamlessly across web, mobile, and physical administrative touchpoints.

Figure 1 presents a proposed multi-tier conceptual system architecture for an intelligent citizen grievance management platform, synthesized from the reviewed literature. The framework is designed



Fig. 1. Proposed conceptual architecture for an intelligent, multilingual citizen grievance management platform (conceptual, not experimentally validated).

Layers 1 and 2 handle input ingestion across diverse channels and standardize raw input into

anonymized, actionable digital representations. Layers 3 and 4 form the computational core, leveraging cross-lingual neural models to categorize grievances and compute dynamic urgency scores. Layer 5 provides Retrieval-Augmented Decision Support for administrative officers, while Layer 6 manages automated ticketing and SLA tracking. Finally, Layer 7 maintains continuous fairness auditing and privacy-preserving model retraining.

VI. RESEARCH GAPS AND FUTURE DIRECTIONS

Table 2 details the core research gaps identified across the reviewed literature along with corresponding future research trajectories.

Table 2. Key research gaps and future directions in AI-driven grievance management

Gap Supported by Evidence	Supporting Studies	Future Research Direction
Single-jurisdiction and synthetic dataset validation	[1], [2], [7], [8]	Multi-region, real-world deployment benchmarks across municipal and national platforms
Low accuracy on code-mixed and low-resource regional dialects	[3], [6], [13]	Development ofdomain-specific vernacular corpora and specialized cross-lingual embeddings
Systemic demographic and geographic bias in priority scoring	[4], [11], [19]	Incorporate algorithmic fairness metrics and dynamic bias auditing into routing engines
High inference latency and API cost of LLM decision support	[9], [14], [15]	Model quantization, knowledge distillation, and lightweight open-source fine-tuning
Citizen privacy exposure in centralized petition logging	[18], [22]	Implementation offederated learning frameworks and local differential privacy protocols
Lack ofcontinuous feedback loops between citizens and AI models	[5], [10], [12]	Human-in-the-loop (HITL) reinforcement learning based on officer and citizen satisfaction feedback

VII. CONCLUSION

Intelligent AI-driven governance platforms hold transformative potential for optimizing citizen grievance management, reducing departmental response latencies, and ensuring equitable administrative redressal. This review has synthesized

technological developments spanning multilingual NLP, Vision Transformer OCR, aspect-based sentiment urgency scoring, and LLM-assisted decision support. While current deep learning models demonstrate high accuracy under laboratory conditions, successful field deployment requires overcoming substantial challenges related to regional dialect handling, algorithmic bias

mitigation, edge efficiency, and privacy preservation. The proposed 7-layer conceptual architecture provides a holistic framework to guide future research, system development, and trustworthy public sector integration.

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