

NearMe: A Comprehensive Survey on Citizen-Centric Civic Grievance Redressal, Spatial Telemetry Triage, and Automated Multi-Departmental Workflow Systems for Smart Cities

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Abstract - Rapid urbanization in developing countries has created immense pressure on municipal corporations and urban local bodies. Traditional civic grievance reporting mechanisms including physical office visits, telephonic hotlines, and unstructured web forms suffer from severe communication gaps, complete absence of spatial telemetry, zero tracking transparency, and protracted resolution delays. Citizens frequently observe hazardous public infrastructure failures such as severe road potholes, non-functional streetlights, illegal waste dumping, and burst water pipelines yet lack an accessible, transparent digital medium to notify governing authorities. Official Ministry of Road Transport and Highways (MoRTH) data indicates that over 3,500 fatal accidents occur annually in India attributable to unaddressed road potholes alone. This survey paper presents a comprehensive analytical investigation into the design, architecture, and deployment paradigms of next-generation Citizen-to-Government (C2G) grievance redressal platforms, conceptualized through the proposed "NearMe" ecosystem. We synthesize empirical findings from contemporary literature spanning mobile crowdsourcing, Geographic Information Systems (GIS), space-time demand forecasting, deep-learning complaint categorization, and public-sector digital goods. Furthermore, we articulate a dual-tier responsive interface model that bridges grassroots citizen reporting with structured departmental enterprise workflows, ensuring auditable status lifecycles, anti-duplicate clustering, and photographic verification of public service delivery.

Key Words: Civic Grievance Redressal, Smart Cities, Mobile Crowdsourcing, GIS Geotagging, Municipal Service Integration, Digital Public Goods, Public Infrastructure Management, C2G Platforms.

1. INTRODUCTION

In contemporary municipal governance, the functional integrity of local physical infrastructure directly dictates public safety, urban economic productivity, and citizen quality of life. Common infrastructural hazards such as cratered roadways, open manholes, and deep potholes lead directly to frequent vehicular accidents, severe

traffic bottlenecks, physical trauma, and avoidable loss of life. Concurrently, unattended solid waste accumulation fosters municipal health epidemics and pest propagation; broken streetlights compromise pedestrian safety and elevate street-crime vulnerability after dusk; and unaddressed water supply pipeline ruptures squander millions of liters of potable water daily while flooding urban thoroughfares.

Real-World Governance Realities & Statistics: In urban agglomerations such as Pune and the Pimpri-Chinchwad Municipal Corporation (PCMC) region, civic authorities receive upwards of 12,000 grievance calls every month during monsoon seasons. Over 45% of these pertain to road potholes and water-logged pavement. Under traditional manual reporting mechanisms, citizen complaints take an average of 14 to 28 days to navigate through administrative red tape, with citizens receiving zero auditable updates on progress. At the national scale, data published by the Ministry of Road Transport and Highways (MoRTH) reveals that road defects and unattended potholes contribute to over 3,597 fatalities and 25,000+ severe injuries annually across Indian roads.

Despite the formal mandate of municipal administrations, a critical structural disconnect persists between civic hazards experienced on the ground and administrative awareness. Historically, civic complaints have operated through three defective conduits: (1) physical in-person visits to ward offices, which impose heavy travel and wage losses on common citizens; (2) generic toll-free contact numbers or email inboxes, which lack visual evidence, precise geospatial telemetry, and auditable accountability; and (3) departmental silos, wherein a citizen reporting a broken road over an electrical trench is passed back and forth between public works and power departments without any resolution.

To overcome these systemic bottlenecks, modern digital public infrastructure must leverage the ubiquitous penetration of smartphones and GPS sensor suites across urban and semi-urban populations. The proposed "NearMe" platform introduces a decentralized, camera-first civic reporting ecosystem. By empowering any

pedestrian or commuter to instantly capture geotagged visual evidence of infrastructural decay, choose or auto-route the relevant civic department (Roads, Electrical, Sanitation, Water Works, or an assisted “Other” triage queue), and monitor progress via a multi-stage status lifecycle (Reported → Assigned → In Progress → Resolved), the system transforms everyday citizens into active stakeholders in urban co-governance.

2.LITERATURE SURVEY

To establish a rigorous theoretical and empirical foundation for the NearMe platform, we examined peer-reviewed research across international conferences and journals spanning 2010 to 2026. The literature is categorized into four thematic clusters:

2.1 Citizen Engagement & Mobile Crowdsourcing:

Saravanan et al. (2024) [1] demonstrated that municipal responsiveness improves by over 60% when citizens report civic issues through unified mobile apps with photos, GPS, and tracking IDs. Hansen & Dahiya (2025) [2] evaluated Bangkok's Traffy Fondue platform, demonstrating that AI-supported citizen-engagement achieved an 84% citizen satisfaction rate, resolved 300,000+ civic issues, and generated US\$2.14 million in annual public savings. Ruiz-Correa et al. (2017) [10] developed SenseCityVity in Mexico, demonstrating that crowdsourcing location-tagged media fosters collective community action. Diop et al. (2022) [9] systematically reviewed crowdsourcing across 78 studies, identifying that simple, low-bandwidth interfaces with voice inputs are essential in the Global South.

2.2 Departmental Silos & 311 Centers:

Nam & Pardo (2014) [7] investigated municipal service integration across New York and Philadelphia 311 centers, finding inter-departmental fragmentation as the primary delay factor. Tiwari et al. (2026) [12] proposed TriSeva, highlighting role-based access control (RBAC), statutory SLAs, and auditable escalation triggers. Minelli & Ruffini (2018) [5] evaluated 698 complaints, discovering that systematic feedback analysis shifts municipal management from reactive firefighting to preventative maintenance.

2.3 Spatial GIS Analysis & Digital Divide:

Van Teeffelen & Baud (2011) [3] and Shirke & Kulshrestha (2026) [4] examined grievance redressal across Hubli-Dharwad and Ahmedabad slums, proving that conventional e-governance fails the urban poor due to complex UIs, forcing reliance on intermediaries. Martinez et al. (2011) [16] evaluated Kalyan-Dombivli using geocoding, proving that complaints do not naturally cluster in deprived areas unless reporting is camera-centric. Richter & Georgiadou (2016) [15]

analyzed GIS property mapping, proving that rigid boundaries need flexible grassroots channels. Srinivasan et al. (2026) [11] analyzed digital public goods across urban local bodies in four Indian states, emphasizing open-source architectures and trained ward personnel.

2.4 Machine Learning & Automated Triage:

Juell-Skielse (2010) [14] proved that visual evidence reduces false reports by 72%. Xu et al. (2017) [8] modeled 311 requests using adaptive space-time kernel estimation (ASTKE) to forecast pothole clusters. Shama et al. (2024) [13] developed CitySolution, using deep learning to categorize complaints from photos. Madyatmadja et al. (2023) [19] evaluated algorithms on the LAKSA platform, showing Support Vector Machines (SVM) achieved 89.2% accuracy. Chen et al. (2022) [20] introduced the IGCP framework with automated label correction. Lim et al. (2019) [18] and Malek et al. (2021) [17] emphasized data privacy and social inclusion.

Table 1: Comparative Evaluation of Civic

Platform	Visuals	Telemetry	Triage	Tracking
Ward Call	None	Text	Manual	None
Web Portal	Optional	Manual Addr	Dropdown	Basic ID
Traffy Fondue	Photo	GPS Geotag	AI-Assist	Push Notif
SenseCityVity	Photos/Audio	GPS Geotag	Research	Unidir
CitySolution	Camera	GPS Geotag	Deep Learn	Dashboar
NearMe (Ours)	Camera+EXIF	Dual GPS	Auto+Desk	4-State+After

Frameworks

4.PROPOSED “NEARME” ARCHITECTURE & WORKFLOW

The proposed NearMe platform is structured around a decoupled, four-tier architecture designed to provide seamless usability for citizens and structured triage for municipal departments:

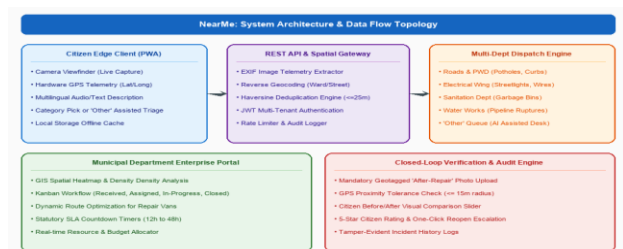


Fig 1: NearMe System Architecture & Data Flow Topology

4.1 Citizen Interface (Camera-First Ingestion)

The citizen client operates as a Progressive Web Application (PWA) with native hardware camera access. Upon capturing a photograph, the client automatically extracts metadata from camera telemetry:

Telemetry={ Lat: ϕ , Long: λ , Accuracy: $\pm\epsilon$, Timestamp:T0 }

Reverse geocoding resolves latitude and longitude into street names and municipal ward numbers. The citizen enters a description and selects a department: Roads & Transport, Electrical & Energy, Sanitation & Waste, Water Supply, or Other / Help Me Route.

4.2 Anti-Duplicate Geospatial Clustering

To prevent duplicate flooding, the backend executes a spatial proximity query using the Haversine metric whenever a new ticket is submitted:

$$d=2R \cdot \arcsin(\sqrt{(\sin^2(\Delta\phi/2) + \cos(\phi_1)\cos(\phi_2)\sin^2(\Delta\lambda/2))})$$

3.PROBLEM FORMULATION & GAPS

Analysis of existing municipal systems highlights four fundamental operational failures:

- **Ambiguity & Verification Deficit:** Text-only complaints lack severity evidence. Municipalities waste fuel on trivial issues while catastrophic road cave-ins remain unattended.
- **Duplicate Flooding:** When a pothole appears on an arterial road, hundreds of commuters file independent complaints, flooding databases with duplicate records.
- **Citizen Department Confusion:** Citizens cannot determine if water accumulation is due to road drainage (PWD) or water pipe bursts. Misrouted tickets sit idle for weeks.
- **Unverified Closure:** Conventional portals allow contractors to mark tickets 'Resolved' without photographic proof, causing premature closure of unaddressed issues.

If an active ticket of the same category exists within $d \leq 25$ meters, the user is notified: "This issue was reported 2 hours ago. Upvote this ticket?" Upvoting increments priority without creating redundant entries.

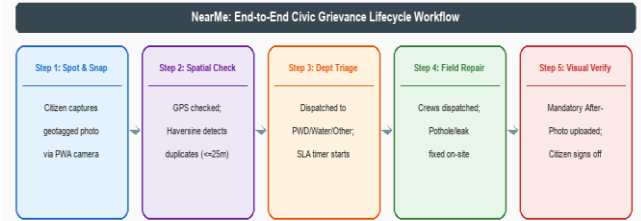


Fig 2: NearMe End-to-End Civic Grievance Lifecycle Workflow

4.3 Departmental Enterprise Triage & SLAs

Authorized departmental officers access an enterprise portal featuring a live GIS cluster map and kanban board. Each department operates under statutory Service Level Agreements (SLAs) enforced by countdown timers:

Table 2: Departmental Jurisdiction & Statutory SLAs

Department	Infrastructure Scope	SLA Target
Roads & PWD	Potholes, pavement, dividers	36 - 48 Hours
Electrical Wing	Streetlights, loose wires	12 - 24 Hours
Sanitation Dept.	Garbage heaps, bin cleanup	12 - 18 Hours
Water Works	Pipeline bursts, sewage leaks	24 - 36 Hours
Other General	Stray cattle, encroachment	24h (Routing)

4.4 Closed-Loop "After-Photo" Verification

To eliminate fraudulent closures, NearMe enforces an immutable rule: A municipal worker cannot mark a ticket "Resolved" without uploading a freshly geotagged "After-Repair" photograph. The backend verifies that after-photo coordinates match the original site within ± 15 meters. Once verified, the citizen receives a before/after comparison slider and a 5-star rating prompt with a one-click Reopen Ticket escalation option.

5.SOCIO-ECONOMIC ADVANTAGES

- **Road Safety & Accident Mitigation:** Early reporting and SLA-bound pothole repair directly prevent two-wheeler skids, axle damage, and fatal road accidents.
- **Elimination of Intermediaries:** Direct smartphone-to-ward routing dissolves bureaucratic gatekeeping, ensuring equal civic service access for marginalized communities.
- **Municipal Resource Optimization:** Spatial heatmaps allow municipal engineers to identify contractor quality deficiencies and schedule preventative resurfacing.

6.CONCLUSION & FUTURE SCOPE

The extensive survey of contemporary civic technology underscores that effective grievance redressal requires a transition from passive bureaucratic recording to dynamic, citizen-centric collaboration. The proposed "NearMe" platform synthesizes camera-first evidence collection, automated geolocation telemetry, anti-duplicate clustering, and auditable departmental workflows to resolve long-standing civic management bottlenecks. Future developments will integrate lightweight computer vision models (such as YOLOv8-tiny) directly on the mobile edge to automatically detect pothole dimensions in real time, as well as predictive space-time kernel forecasting to allocate municipal repair budgets proactively.

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