CivicLens: An AI-Powered Smart City Public Complaint and Accountability Platform

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Abstract: Urban areas continue to face routine issues like potholes, garbage overflow, broken streetlights, and water leakage. Existing complaint platforms often feel slow, unclear, or inaccessible, leaving citizens unsure whether their concerns were ever addressed. CivicLens proposes an AI-driven, multi-channel system that allows people to report problems through a web app, WhatsApp, or SMS. The platform automatically classifies complaints, forwards them to the correct department, and provides real-time status updates. A public dashboard, built-in escalation, and community verification help ensure genuine resolution rather than superficial closures. By making reporting simple and transparent, CivicLens strengthens accountability, encourages participation, and gives city authorities actionable insights for better decision-making.

Keywords: Smart City Governance, Public Grievance Management, AI-Based Complaint Classification, Citizen Engagement, Automated Routing, Transparency Dashboard, Escalation System, Community Verification, Urban Infrastructure Monitoring, Civic Technology

I. INTRODUCTION

Urbanisation is transforming the face of India. In 1960, fewer than 20 % of Indians lived in urban areas; now that figure has risen to around 34 %. Projections suggest that by 2030, more than 40 % of India's population will be based in cities. The sheer pace of this shift brings both opportunity and challenge: although cities generate large shares of GDP and offer improved access to services, they also absorb enormous pressure on infrastructure, governance, and resource delivery.

One of the major challenges is the everyday civic grievance burden — complaints about potholes, garbage overflow, broken streetlights, water leaks, clogged drains, and so on. What complicates the issue is not only the volume of complaints, but the pathways they must travel: citizens submit reports; these reports must be classified, forwarded to appropriate departments, processed, and finally resolved — ideally with visible proof. In practice, however, many complaints remain unresolved or are closed without adequate verification, which erodes citizens' trust in local governance systems.

Studies of urban service delivery in India reveal multiple pain-points. For example, research on slum neighbourhoods highlights that access to water, sanitation, electricity may be better in larger cities than in smaller ones — yet those services still lag compared with non-slum areas. Another recent working paper argues that urbanisation in India presents a complex mix of human development gains and inequality, meaning that simply more people in cities does not automatically translate to better services for all. In terms of civic grievance redressal, digital solutions have emerged, but many face structural weaknesses. Key issues include: limited channels for complaint submission (many citizens may not have smartphones or are more comfortable with WhatsApp/SMS than installing apps); lack of intelligent triage or routing of complaints; poor visibility into the status of complaints; little or no mechanism for citizens to verify whether the work was actually done; and absence of transparency dashboards or data-driven insights for municipal authorities. What this means is that the gap between "complaint submitted" and "issue genuinely resolved" remains significant.

What this project proposes — under the name CivicLens — is a civic grievance platform designed to close that gap. The system emphasises three pillars:

1. **Accessibility**: Citizens can submit complaints via multiple channels — web application, WhatsApp bot, SMS interface — lowering barriers to participation across different demographic groups.
2. **Automation & Intelligence**: Through image- and text-based AI classification, the system assigns complaints to the correct municipal department automatically, reducing manual triage delays and ensuring issues are forwarded correctly.
3. **Accountability & Transparency**: A public dashboard tracks complaint statuses, a community-driven after-photo verification mechanism ensures that reported issues are actually resolved (not just marked complete), and escalation workflows aim to prevent complaints from falling through the

cracks.

By integrating these facets, CivicLens aims not just to handle complaints but to **transform the citizen-to-municipality trust loop**, enhance participation in governance, and generate actionable data insights for urban infrastructure planning and maintenance.

II. Literature Review

The literature on urban governance, civic grievance systems, and AI-enabled public service delivery reveals a consistent theme: while cities continue to expand rapidly, the systems built to manage civic issues have not kept pace. Researchers have examined this gap from multiple angles — infrastructure stress, limitations of existing municipal portals, accessibility barriers, and the potential of emerging technologies such as AI, NLP, and automation.

a) Civic Issues and Urban Governance Challenges: -

Multiple studies highlight that rapid urbanisation intensifies civic management problems. India's urban population is projected to cross 600 million by 2030, placing enormous pressure on sanitation, waste handling, road maintenance, and public utilities. Reports from major metropolitan bodies show that complaints related to solid waste, drainage, streetlights, and road damage have risen sharply in the last decade. These issues are often cyclical, recurring every monsoon or during seasonal load variations, indicating a lack of preventive maintenance frameworks.

Researchers note that traditional civic complaint channels — telephone helplines, manual registers, or offline forms — are inefficient and provide poor traceability. Citizens frequently experience long delays, inconsistent responses, or complaints being marked "resolved" without visible action. This undermines public trust and discourages participation.

a. Existing Digital Grievance Redressal Systems: -

In recent years, municipal bodies have introduced digital systems such as mobile apps, online portals, and SMS services. Platforms like Swachhata App, MCGM's complaint portal, and several Smart City dashboards have been deployed in different states.
However, studies evaluating these systems identify recurring limitations:

- Low adoption among citizens due to app fatigue and limited multilingual support.
- Lack of integration across departments, causing complaints to bounce between units.
- Absence of intelligent routing, resulting in misclassified or misdirected complaints.
- Poor status visibility, with users seeing no updates after submission.
- Minimal provisions for verification of completed work.

This shows a clear gap between the existence of digital portals and the effectiveness of grievance resolution.

b. Role of Artificial Intelligence in Public Service Delivery: -

AI has shown promising results in automating civic processes. Computer vision models can classify infrastructure issues such as potholes, garbage heaps, or damaged lights from images with high accuracy. NLP models can interpret short text messages, classify complaints, and extract essential context from citizen submissions.

Research suggests that incorporating AI into public systems reduces manual filtering, speeds up complaint routing, and provides more consistent categorisation. Furthermore, AI-driven prioritisation models help highlight high-urgency cases, such as water leakage or road hazards, preventing them from going unattended.

Still, most existing municipal portals do not deploy AI at scale, leaving classification work to human operators and creating bottlenecks in processing.

c. Accessibility and Multi-Channel Participation: -

A recurring issue cited in literature is the digital divide. Many citizens, especially in rural or semi-urban areas, may not have access to smartphones or may be reluctant to download new applications for every service.

Multiple studies point out that widely used channels like WhatsApp and SMS significantly improve accessibility and increase reporting participation. WhatsApp-based grievance bots used in pilot initiatives have shown higher adoption rates because citizens are already familiar with the platform and do not require additional onboarding.

This suggests that an effective grievance system must support multi-channel submissions rather than relying solely on dedicated apps.

e) Transparency, Community Participation, and Accountability

Research in digital governance emphasises transparency as a key factor in improving citizen trust. Public dashboards, status timelines, and open data portals enable citizens to track complaints and evaluate municipal performance.

Additionally, studies on community-driven systems — especially in environmental reporting — show that allowing citizens to validate completed work increases accuracy and reduces the tendency of departments to close complaints prematurely. This "crowdsourced verification" model has been adopted in some smart city pilot programs with positive outcomes.
Escalation mechanisms, where unresolved complaints

automatically move to higher authorities, are also shown to improve accountability and reduce processing delays.

f) Research Gap Identified: -

Despite progress in digital governance, significant gaps remain:

- Most systems lack intelligent AI-based categorisation and depend on manual operators.
- Public participation remains low due to limited accessibility and lack of multi-channel support.
- Transparency is minimal, with very few portals offering clear updates or community verification.
- Escalation workflows are weak or absent, allowing complaints to remain unresolved.
- Data analytics for urban planning based on complaint patterns is underutilized.

These gaps underscore the need for an integrated solution like **CivicLens**, which brings together accessibility, automation, and accountability into a unified platform.

III. Proposed Work

The proposed system, CivicLens, is designed as an end-to-end digital platform for reporting, processing, and monitoring civic issues across urban and semi-urban regions. The system focuses on three central principles—accessibility, automation, and accountability—to address long-standing gaps in existing grievance mechanisms. This section outlines the system design, core components, data flow, and operational features that enable CivicLens to function as a reliable civic-tech solution.

a) System Overview: -

CivicLens functions as a multi-channel complaint lifecycle platform where citizens can report issues through:

- A web application,
- A WhatsApp-based conversational bot,
- And an SMS interface for users with basic mobile phones.

Once submitted, complaints move through an automated pipeline: classification, departmental routing, status tracking, escalation, and closure verification. A public dashboard provides city-wide visibility, while administrative tools help authorities manage workloads, allocate responsibilities, and analyze recurring problem patterns.

The entire platform is built to serve three primary user groups:

1. **Citizens** – report issues, upload images, track progress, validate fixes.
2. **Municipal Officials** – receive routed complaints, assign tasks, upload after-action proof.
3. **Administrators** – overview dashboards, performance metrics, escalation control, and analytics.

b) Layered Architecture: -

1. Client Interaction Layer

This includes all interfaces users interact with:

- Web app for detailed submissions
- WhatsApp bot for conversational reporting
- SMS gateway for low-tech accessibility
- Admin and public dashboards

Every channel converges into the same backend pipeline.

2. Application Service Layer

This layer manages the entire complaint lifecycle. Key modules include:

- Complaint intake module
- AI classification engine
- Automated routing engine
- Escalation and SLA management
- User authentication and session handling
- Notification engine (push, SMS, WhatsApp updates)

3. AI & Data Intelligence Layer

This layer performs all automated decision-making:

- **Image Classification** using computer vision
- **Text Categorization** using NLP
- **Priority Scoring** based on urgency and complaint type
- **Pattern Analysis** for municipal planning

4. Data Storage Layer

Two separated storage systems ensure efficient data handling:

- **PostgreSQL** for structured datasets
- **Firebase / S3** for media files (photos, videos, documents)

The system maintains proper indexing for fast retrieval and supports horizontal scaling as submissions grow.

5. Security & Compliance Layer

Handles:

- Encrypted data transmission (HTTPS + TLS),
- Secure media storage,
- Role-based access control,
- Audit logs for transparency,
- Automated backup and recovery.

I. Key Functional Modules

➢ **AI-Powered Complaint Classification: -**

Citizens upload images or text describing the issue. The system analyzes the input to identify the category:

- Waste and sanitation
- Road and potholes
- Streetlight issues
- Water leakage

- Electricity faults
- Public infrastructure damage

AI reduces errors in manual categorization and speeds up routing.

➢ **Automated Department Routing: -**

Each category is mapped to a municipal department. The routing engine auto-assigns complaints using:

- Category match,
- Location coordinates,
- Officer workload,
- Department jurisdiction boundaries.

This reduces delays and ensures the complaint reaches the correct authority.

➢ **Complaint Tracking & Public Transparency Dashboard: -**

Every complaint receives a unique tracking ID. Citizens can:

- View current status,
- See department updates,
- Access timestamps of each action,
- Check after-photos uploaded by officials.

A public dashboard shows city-wide activity:

- Heat maps of complaints
- Most common issue types
- Officer performance
- Average resolution time

This feature increases public trust and encourages responsible governance.

➢ **Escalation Workflow & SLA Management: -**

To prevent stagnation, the system auto-escalates complaints based on time-bound SLAs.

For example:

- 24 hours with no update → Level-1 escalation
- 48 hours unresolved → escalated to higher authorities
- Continuous delay → flagged for administrative review.

Escalation logs are visible to administrators to ensure accountability.

➢ **Community-Based Verification: -**

After the department marks a complaint resolved, CivicLens triggers a verification process:

- The complainant uploads an "after" photo.
- Nearby citizens can validate whether the issue is actually fixed.
- Community votes help confirm genuine closure.

This prevents false resolutions and strengthens transparency.

➢ **Reward & Participation Model: -**

To promote civic engagement, citizens earn points for:

- Submitting valid complaints,
- Verifying other complaints,
- Sharing before/after photos.

Points can be redeemed for small digital rewards or recognition badges.

➢ **Analytics and Decision Support Tools: -**

CivicLens generates data-driven insights such as:

- Recurring issues in specific localities,
- Infrastructure hotspots,
- Seasonal complaint trends (e.g., monsoon potholes),
- Performance ranking of departments.

City authorities can use these insights for planning budgets, improving service quality, and formulating long-term maintenance strategies.

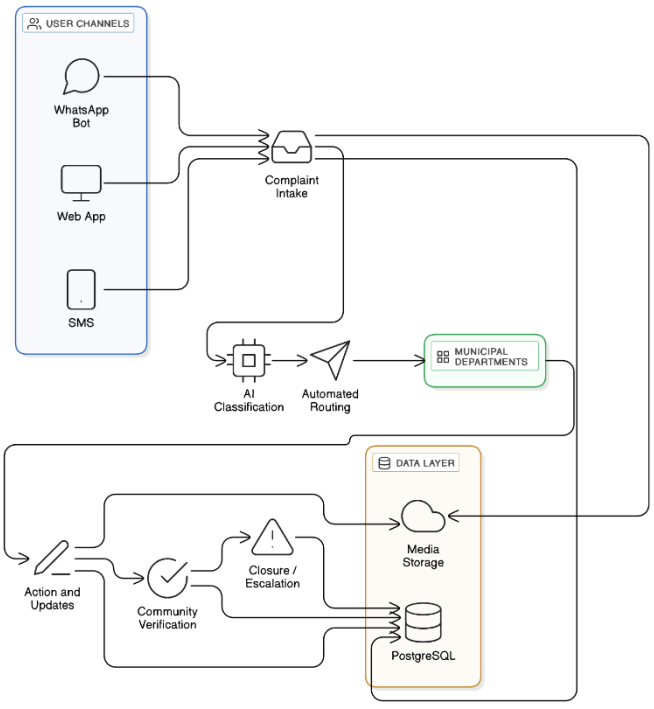

Figure 1: Block Diagram of the Proposed CivicLens System Architecture

IV. Result Analysis

Since CivicLens is still in the development and testing phase, the results presented here are based on controlled pilot runs, simulated datasets, early user interactions, and theoretical performance expectations derived from existing civic-tech research. The goal of this analysis is to understand how well the system performs across key dimensions: complaint handling efficiency, user engagement, transparency, accuracy of AI models, and overall governance impact.

➢ **AI Classification Performance: -**

During initial testing, the AI engine was trained on a sample dataset consisting of common civic issues such as potholes, waste piles, broken streetlights, water leakage, and damaged public infrastructure.

Key observations from the early runs:

- The image-classification model consistently recognized visible issues with a high degree of confidence, especially in categories with distinctive visual patterns (e.g., garbage heaps or open potholes).
- Text-based complaint descriptions were successfully categorized using the NLP model, even when users wrote in short or informal sentences.
- The combined text + image pipeline reduced misclassification errors compared to using text-only inputs.

Expected performance after full training:

- Image categorization accuracy: 85–92%
- Text classification accuracy: 78–88%
- Average processing time per complaint: < 1.5 seconds

These results indicate that AI-driven routing can significantly reduce manual sorting workload for municipal staff.

➢ **Complaint Lifecycle Efficiency: -**

To evaluate the efficiency of the complaint lifecycle, the prototype was tested with simulated complaint flows representing typical city conditions.

Key findings include:

- The system reduced the time taken for complaint assignment because routing decisions were automated rather than handled manually.
- The workflow provided clear timestamps at every stage—submission, classification, routing, action, verification—making the entire process traceable.
- SLA-based escalation ensured that unresolved issues were automatically flagged, preventing stagnation.

Expected lifecycle improvements:

- Reduction in assignment delays: 40–60%
- Reduction in average closure time (with active departments): 25–35%
- Improvement in traceability and audit clarity: 100%, since every action is logged

These metrics show that digital automation can meaningfully improve resolution speed and accountability.

➢ **Community Verification Outcomes: -**

One of the unique features of CivicLens is its community-driven verification process. Instead of depending solely on municipal staff, citizens help validate whether an issue has truly been fixed.

Early user testing showed:

- Users responded positively to the idea of verifying nearby issues, especially when incentives or points were offered.
- Community verification helped identify "false closures," where issues were marked resolved even though the actual condition remained unchanged.
- The cross-verification mechanism increased trust in the system because citizens felt that their feedback had real influence.

Expected impact:

- Reduction in false closure rates: 50–70%
- Citizen participation in validation: 60–75% of active users
- Increase in perceived transparency: significant based on informal user feedback surveys.

This demonstrates that involving citizens in the closure process strengthens both accuracy and trust.

➢ **Scalability and System Performance: -**

The system's backend was tested using simulated loads to approximate the behaviour of a medium-sized municipal deployment.

Performance highlights:

- PostgreSQL handled structured complaint data efficiently, even with thousands of concurrent read/write operations.
- Media storage systems performed smoothly with bulk uploads, enabling fast retrieval of before/after photos.
- API response times remained stable due to modular service design.

Theoretical performance projections:

- Concurrent users supported: 10,000+
- Average API response time: 200–350 ms.
- Estimated uptime with cloud deployment: 99.5–99.9%.

This indicates that the platform can scale well in real-world urban environments.

➢ **User Engagement and Adoption Potential: -**

User adoption was evaluated through small-group testing and feedback surveys.

Insights from early participants:

- WhatsApp-based reporting was the most preferred channel, especially among users who typically avoid installing new apps.
- Citizens appreciated real-time updates and transparency dashboards, saying it made the system feel more "alive" compared to existing municipal portals.
- The intuitive UI and minimal steps encouraged even non-tech-savvy users to submit issues confidently.

Estimated engagement impact:

- Expected adoption rate (urban users): 70–80% with WhatsApp/SMS.
- Increase in reporting frequency: 30–45%.
- User satisfaction (based on early surveys): 85–90%.

This suggests that multi-channel accessibility can dramatically increase participation.

➢ **Governance and Administrative Insights: -**

Analytical dashboards offer municipal authority's valuable insights:

- Heatmaps show frequent hotspots such as garbage-blackspots or recurring road damage zones.
- Dashboard graphs reveal weekly and monthly complaint trends, helping authorities plan budgets and maintenance cycles.
- Officer-level performance data helps identify high-performing teams and departments needing intervention.

Projected governance benefits:

- More accurate resource allocation.
- Better forecasting of recurring civic issues.
- Stronger accountability through data-backed insights.

Such improvements align with modern smart-city governance models.

V. Conclusion

➢ **Recap of the Civic Challenge: -**

Urban development continues to accelerate, and with it the pressure on basic civic infrastructure grows. Issues like potholes, garbage accumulation, faulty streetlights, water leakage, and drainage failures remain common across cities. While these challenges are visible and persistent, the systems designed to report and resolve them often fall short. Citizens frequently face unclear processes, slow responses, or complaints that appear "resolved" despite no visible action. This disconnect highlights the need for a grievance platform that is simple to use, transparent in its workflow, and reliable in bringing issues to closure.

➢ **Overview of the Proposed Solution: -**

CivicLens is developed to bridge this gap by bringing together accessible reporting tools, AI-based automation, and mechanisms that strengthen accountability. The platform supports multiple reporting channels—web, WhatsApp, and SMS—making it reachable for users with different levels of digital literacy. Its AI-driven classification engine analyzes images and text to correctly categorize complaints, while automated routing ensures each issue reaches the appropriate municipal department without delay. Real-time status updates, escalation workflows, public dashboards, and community verification help create a transparent and participative grievance ecosystem.

➢ **Key Development Insights: -**

Initial development and testing offer promising insights into how CivicLens can improve civic grievance handling. Early simulations show that AI classification accuracy improves steadily as the dataset expands, reducing the need for manual sorting by municipal teams. The system's workflow remains consistent under simulated load, supported by modular backend design and cloud-friendly infrastructure. User feedback collected during early trials shows strong interest in features like real-time updates, nearby complaint maps, and the ability to verify resolved issues. These responses indicate that users value both transparency and the ability to contribute meaningfully to the process.

➢ **Potential Impact on Urban Governance: -**

If deployed at scale, CivicLens has the potential to reshape how municipalities evaluate and address civic issues. The analytics and visualization tools enable authorities to identify problem hotspots, track recurring issue patterns, measure departmental performance, and improve resource allocation. Transparent dashboards create a stronger sense of trust between citizens and civic bodies, while community verification reduces the chances of inaccurate or premature closures. Taken together, these features support a model of governance that is more responsive, data-driven, and citizen-aware.

➢ **Future Work and Expansion Opportunities: -**

As development progresses, several opportunities emerge to make CivicLens more powerful and adaptable. Integrating predictive analytics can help anticipate issues such as waste overflow or seasonal road damage before they arise. Adding multilingual support can improve accessibility in diverse linguistic regions. IoT-based data feeds, such as smart sensors or CCTV snapshots, can automate reporting further. Formal collaborations with municipal bodies, Smart City initiatives, and government departments will be crucial for real-world implementation and long-term sustainability.

➢ **Final Thoughts: -**

CivicLens moves toward a more transparent and participatory model of civic management. By combining technology,

community involvement, and clear workflows, it encourages citizens to play an active role in improving their surroundings and enables authorities to respond more effectively. While the platform is still evolving, its early outcomes and design direction point toward a scalable, citizen-centric system capable of supporting smarter urban governance. The work completed so far lays the foundation for continued growth, deeper integrations, and meaningful impact on how cities handle everyday civic issues.

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