



Smart Nagar Citizen Portal: A Unified AI-Assisted Platform for Civic Issue Reporting and Resolution

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ABSTRACT—

Municipal governments handle everyday civic problems such as potholes, garbage overflow, broken street lights, water leakage, illegal parking and drainage issues through complaint channels that are often manual, fragmented and slow to close the loop with citizens. This paper reviews existing literature relevant to the design of an AI-assisted Smart Nagar Citizen Portal. The review is organised around four themes: crowdsourced civic issue reporting platforms, AI-based image classification of civic issues, NLP-based complaint classification with duplicate detection and chatbots, and predictive analytics with IoT-enabled hotspot mapping. The reviewed work includes platforms such as SeeClickFix and FixMyStreet, deep-learning pothole and waste classifiers, semantic-clustering approaches to duplicate complaints, and predictive-maintenance research in smart-nagar infrastructure. A consistent gap is identified: existing systems tend to address reporting, classification, deduplication or prediction in isolation rather than as one integrated pipeline driven by citizen-submitted data. The proposed portal maps these findings to citizen reporting, administrator/worker workflow, and an AI layer for classification, deduplication, chat support and trend prediction.

Keywords— Smart Nagar; Civic Issue Reporting; Crowdsourcing; Image Classification; Natural Language Processing; Duplicate Detection; Chatbot; Predictive Analytics; IoT.

I. INTRODUCTION

Over the last decade, research and applied systems have examined three overlapping problems in civic-issue management: enabling citizens to report issues easily and track them transparently; using artificial intelligence to read the content of a report, whether photo or text, for classification, prioritisation and de-duplication; and helping municipalities move from reactive complaint handling toward predictive, data-driven planning. The proposed Smart Nagar Citizen Portal is positioned as an AI-assisted platform through which citizens can report issues with photographs and GPS location, track status and rate resolution, while administrators assign work. Its AI layer is intended to classify issues, detect duplicate reports, provide chatbot support and summarise trends. The literature review motivates this combination by showing that these individual capabilities are each represented in prior work, but are less commonly integrated into a single end-to-end citizen-driven workflow.

II. LITERATURE REVIEW / RELATED WORK

A. Crowdsourced Civic Issue Reporting Platforms

Early civic-technology systems such as SeeClickFix and FixMyStreet allow residents to submit free-text or photo-based reports that are aggregated on public maps. SeeClickFix was studied as an example of distributed democracy and was shown to support multi-platform reporting, status feedback loops, social-media integration and government back-end integration. FixMyStreet has been studied in cities such as Brussels; an analysis of more than 30,000 reports found substantial variation in participation across ethnically and socio- economically diverse districts, raising concerns about the digital divide.

Research in the Indian context has also examined how citizens and police use online social networks to raise and respond to public-safety and civic concerns. Reported challenges include acknowledgement overload and differing expectations of responsiveness, which are directly relevant to notification and status-tracking design. More recent surveys note that reporting platforms can capture GPS-tagged, photo-attached reports and improve engagement, but generally lack machine-learning verification, duplicate-report detection and intelligent automation. Common feasibility risks include spam or fake reports, slow government response, data-privacy exposure, low sustained engagement and institutional resistance to transparency.

B. AI-Based Image Classification for Civic Issue Detection

Computer-vision research applies deep learning to recognise the type and severity of civic issues from photographs. Pothole-detection studies use deep-learning models and datasets containing road imagery, while reviews of pavement-distress research describe a progression from classical image processing toward CNN- and YOLO-based pipelines. In waste management, a hardware-integrated system paired a Raspberry-Pi camera with pretrained CNN backbones including AlexNet, ResNet, VGG- 16 and InceptionNet, with InceptionNet reported as the strongest performer for distinguishing biodegradable from non-biodegradable waste.

CitySolution is particularly close to the proposed portal structure: it used Google's Teachable Machine with lightweight CNN/MobileNet transfer learning to classify citizen-submitted photographs into categories such as damaged road, flood, trash and homeless-related issues in a mobile complaint-distribution application. Collectively, this work demonstrates the feasibility of image classification for individual civic issue types, while also showing that many systems remain single-purpose rather than serving as unified classifiers in a general citizen portal.

C. NLP-Based Complaint Classification, Duplicate Detection and Chatbots

Text-based complaint processing has developed alongside image classification. A 2025 semantic-pattern-recognition framework for public -sector complaint logs used BERT-based sentence embeddings and clustering to group semantically similar complaints even when residents phrase the same issue differently. The study reported a reduction in repeated complaint categories and increased classification efficiency, and highlighted the limitations of keyword matching for duplicate or near -duplicate complaints expressed in diverse language.

Other systems, including CivicSense, combine generative AI and NLP to rank and summarise large volumes of unstructured complaints into structured insights. 311-style chatbots have also been studied as engineering solutions for providing residents with a 24/7 channel for non -emergency reports. Research on a metro-city 311 chatbot indicates that different socio-economic groups can prioritise different categories of civic issues, which is a relevant consideration for a diverse citizen-facing chatbot.

D. Predictive Analytics, Hotspot Mapping and IoT in Smart Cities

The final theme concerns moving from individual complaint handling toward city-wide predictive planning. IoT-oriented smart-nagar research has applied machine-learning models such as Random Forest and decision-tree variants, together with unsupervised methods, to street- light sensor data to support predictive maintenance. Federated-learning approaches have also been explored for street-light monitoring to reduce communication cost and preserve privacy across distributed municipal sensor networks.

However, this predictive and IoT literature is largely sensor-driven rather than based on citizen-submitted complaint data. Conversely, the civic-reporting literature reviewed rarely closes the loop by feeding classified, geotagged complaints into a predictive hotspot model. This separation motivates the proposed portal's hotspot-heatmap and trend-analysis direction.

III. PROBLEM STATEMENT

The literature indicates that civic reporting, image classification, complaint deduplication, conversational support and predictive analytics are commonly implemented as separate point solutions. A practical problem therefore remains in integrating these capabilities into a single citizen-driven workflow in which a photo-and-location complaint can be classified, checked against nearby duplicate reports, routed for work and incorporated into city-wide trend analysis.

IV. OBJECTIVES

1. Provide citizen reporting using photographs and GPS location.
2. Support transparent complaint status tracking and resolution rating.
3. Provide an administrative/worker workflow for assigning reported issues.
4. Apply AI-based image classification to civic-issue photographs.
5. Use NLP/semantic methods and location, image and text signals to identify duplicate or near-duplicate complaints.
6. Provide chatbot support and summarise complaint trends.
7. Use complaint history for hotspot and predictive trend analysis.

V. PROPOSED SYSTEM

A. System Overview

The proposed Smart Nagar Citizen Portal is a unified platform that connects citizen reporting, administrative/worker processing and an AI layer. A citizen submits a complaint with a photograph and GPS location, tracks its status and can rate the resolution. Administrators can assign work to workers. The AI layer is designed to classify the reported issue, detect duplicate complaints, support citizens through a chatbot and summarise or predict complaint trends.

B. Main Features

- Citizen issue reporting with photo and GPS location.
- Complaint status tracking and resolution rating.
- Administrator/worker assignment workflow.

- AI-based category and severity classification.
- Duplicate merging using location, image and text signals.
- Chat support for citizen queries.
- Trend and hotspot analysis using complaint history.

C. Functional Requirements

The citizen module should allow a user to create a complaint, select or confirm its category, attach a photograph, provide a location, submit a description and receive a unique complaint identifier. The user should be able to view the current status and review the closure information. The administrator module should provide a queue of incoming reports, filtering by category, date, location and priority, and options to assign a report to the appropriate municipal team. Workers should be able to update progress, add resolution notes and attach evidence of completed work.

D. Non-Functional Requirements

The portal should be accessible on common mobile and desktop browsers, use clear language and avoid unnecessary steps during complaint submission. Reliability is important because a citizen should not lose a report when the network is interrupted. The system should validate inputs, record important status changes and protect user information through authentication and role-based access. Performance, accessibility, maintainability and compatibility should be treated as quality goals and checked during testing rather than assumed to have been achieved.

E. Complaint Lifecycle

A typical complaint lifecycle can be represented as: Submitted → Validated → Categorised → Assigned → In Progress → Resolved → Citizen Feedback → Closed. If a complaint is incomplete, the system may request additional information. If a report is found to be a duplicate, it can be linked to an existing complaint while retaining the new reporter's reference and notification history. If the citizen disagrees with the closure, the portal should provide a defined reopen or review process. These states make the workflow understandable to citizens and help administrators identify delayed cases.

VI. SYSTEM ARCHITECTURE

The conceptual workflow connects the citizen interface with the portal frontend, backend/AI services, database and analytics. The supplied literature review defines the functional workflow but does not provide a final implementation-specific architecture diagram.

Citizen Frontend / Portal → Backend / AI Layer → Database & Analytics

Photo + GPS; Complaint + tracking; Reporting; Status view; Chat support → Classification; Deduplication; Chatbot; Trend analysis → Complaint history; Locations; Hotspots

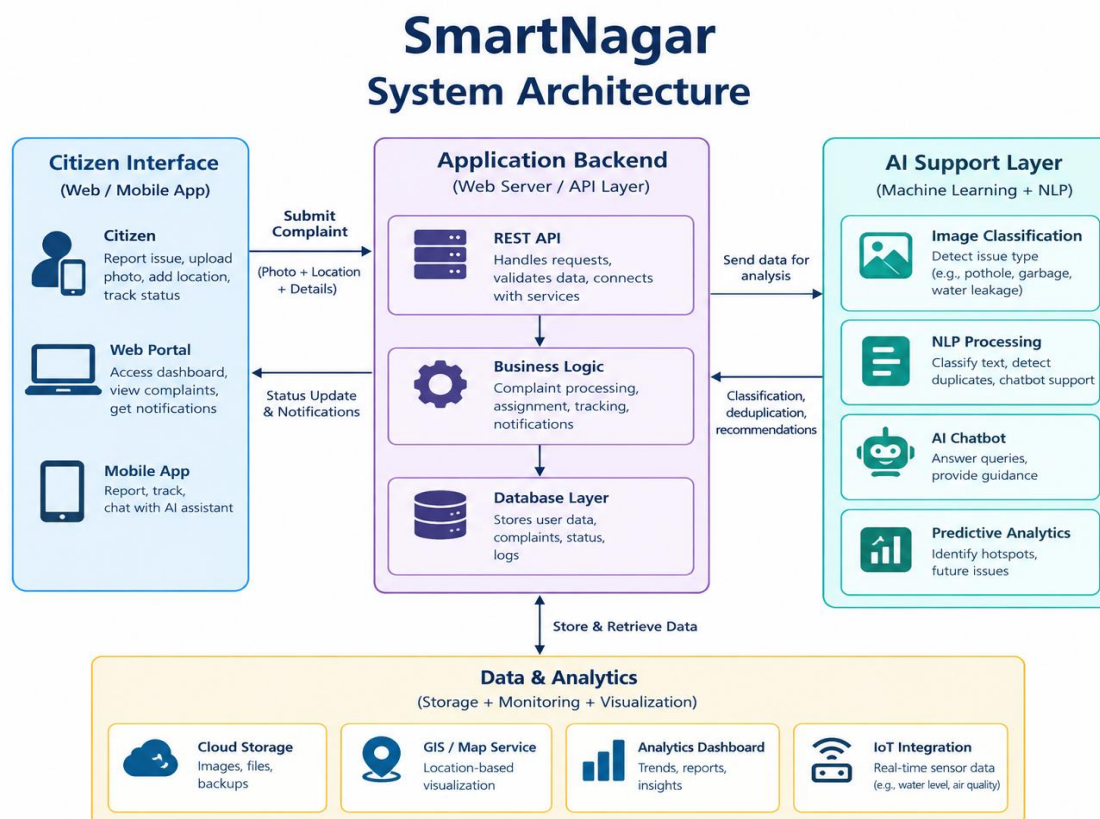


Fig. 1. System Architecture of SmartNagar

Fig. 1. Conceptual architecture of the proposed Smart Nagar Citizen Portal.

The final paper should replace this conceptual view with the team's actual architecture, including the implemented frontend, backend/API, database and external services.

A. Data Flow

At submission, the frontend collects the complaint description, category if selected, image and location with the user's permission. The backend validates the request, stores the complaint record and media reference, and initiates AI-assisted processing where available. The classification service can suggest a category and priority; a duplicate-detection service can compare the new report with recent complaints using text similarity, geographic proximity and image features. The administrator reviews the available information before final assignment. Status changes are stored in the database and made visible through the citizen dashboard.

B. Core Data Entities

A possible database design contains the following entities: User (user identifier, contact preference and role); Complaint (complaint identifier, description, category, timestamp, location and status); Attachment (file reference and upload metadata); Assignment (complaint, responsible team, assigned time and due date); StatusHistory (previous state, new state, timestamp and authorised actor); Feedback (rating and optional comment); and Notification (recipient, message type, delivery state and timestamp). This is a proposed logical model. The final entity fields and relationships should be aligned with the database actually implemented by the project team.

C. AI Assistance and Human Oversight

AI outputs should be treated as decision support, not as unquestionable decisions. For example, a photograph classifier may suggest "road damage," but the administrator should be able to correct the category when the image is unclear or the complaint context differs. Confidence scores can be used to route low-confidence cases for manual review. Similarly, duplicate detection should recommend likely matches rather than automatically deleting reports, because two nearby issues may be distinct. Maintaining a record of human corrections can help the team identify recurring model errors during evaluation.

VII. METHODOLOGY

1. Literature and requirement analysis based on civic-reporting, AI classification, NLP, chatbot and predictive-analytics studies.
2. System design around citizen reporting, administrator/worker workflow and an AI layer.
3. Integration of image, text and geospatial signals for classification and duplicate detection.
4. Complaint-history analysis for hotspot/trend identification.
5. Testing and evaluation of portal functionality and AI modules.

A. Data Preparation

Before training or evaluating an image or text model, the team should define the supported complaint categories and prepare a labelled dataset that reflects the conditions in which the portal will be used. Image samples should include variation in lighting, weather, camera quality, distance and viewing angle. Text samples should include spelling variations, local expressions and short or incomplete descriptions. Duplicate records must be checked carefully so that closely related examples do not unintentionally appear in both training and test sets. If a public dataset is used, its licence, provenance and suitability for the target city should be recorded.

B. Model Selection and Integration

A lightweight transfer-learning image classifier, such as a MobileNet-based approach discussed in the reviewed literature, may be considered when computation and response time are important constraints. For text, sentence embeddings and semantic similarity can support the identification of reports that describe the same issue using different wording. A geospatial filter can narrow duplicate candidates to a nearby area and a relevant time window. The choice of model should be based on a comparison of accuracy, computational cost, inference time, maintainability and performance on local examples. The research paper does not claim that a particular model has already been trained or validated for Smart Nagar.

C. Testing Strategy

Functional testing should verify that a complaint can be submitted, stored, assigned, updated, resolved and displayed correctly to the citizen. Integration testing should check communication between the frontend, API, database, image storage and AI services. Usability testing should observe whether users can report an issue without assistance and understand the status labels. Security testing should include unauthorised access attempts, invalid uploads, input validation and access to another user's complaint. AI tests should include normal cases, difficult examples, incorrect predictions and duplicate reports that are close in location but refer to different problems.

VIII. TECHNOLOGIES USED

The supplied literature review identifies or discusses CNN/MobileNet transfer learning, YOLO, BERT sentence embeddings, semantic clustering, generative AI/NLP, Random Forest, decision trees, unsupervised learning and federated learning in related research. It does not specify the exact software stack, programming language, database, frontend framework or hosting environment actually used by the project team. The final paper should therefore replace this subsection with the team's verified technologies rather than assuming technologies from the reviewed papers.

IX. IMPLEMENTATION

The proposed implementation is organised around three major parts: a citizen-facing reporting and tracking workflow, an administrator/worker workflow for assignment and resolution, and an AI layer for classification, duplicate detection, chatbot support and trend analysis. The literature review specifically proposes combining category and severity classification, duplicate merging using location/image/text signals, structured worker assignment, and complaint-history hotspot analytics.

Implementation screenshots, database/API details, source-code architecture and measured execution results were not included in the supplied literature-review paper. These should be added from the actual project implementation before final submission.

A. Suggested Implementation Modules

The frontend module is responsible for forms, location permission, complaint lists, status timelines and feedback. The backend module manages

authentication, validation, complaint records, assignments and status transitions through defined API endpoints. The database stores structured records, while image files may be kept in file or object storage with controlled access. The AI module exposes services for image classification, text similarity and trend analysis. The notification module informs citizens when a complaint is acknowledged, assigned, updated or closed. Separating these responsibilities can make the system easier to test and maintain.

B. Error Handling and Operational Reliability

The system should give useful feedback when a photograph is too large, location permission is denied, a required field is missing or a network request fails. A failed AI prediction should not prevent a valid complaint from being submitted; instead, the report can be saved for manual categorisation. Repeated submissions caused by slow network responses should be controlled using a unique request identifier or another idempotency mechanism where feasible. Administrators should also be able to see unresolved failures and retry background processing without creating duplicate complaint records.

C. Implemented User Interface and Prototype Screens

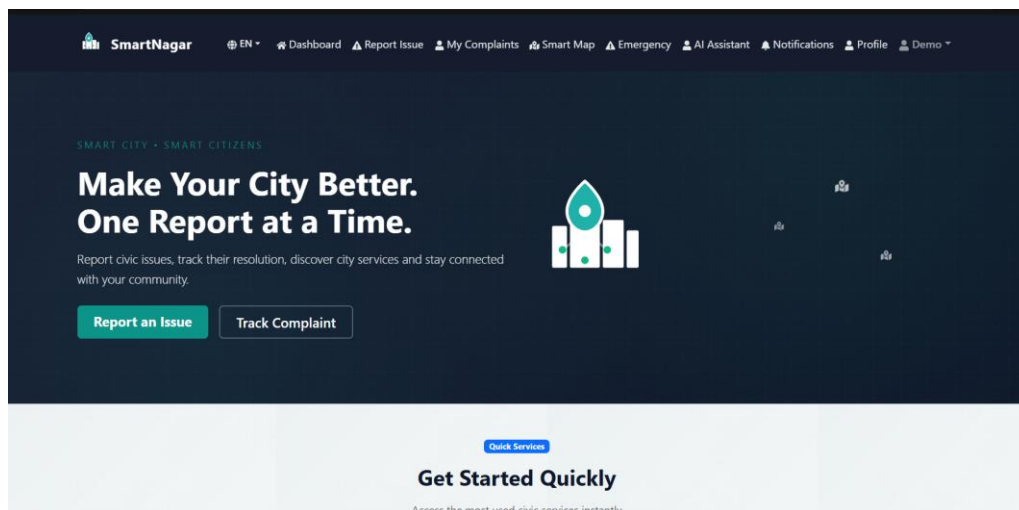


Fig. 2. SmartNagar home page showing the main navigation, introductory banner, and quick actions for reporting and tracking civic issues.

The home page acts as the entry point to the portal. It presents the SmartNagar identity and provides direct navigation to the dashboard, issue reporting, complaint tracking, map, emergency services, AI assistant, notifications, and profile. The prominent “Report an Issue” and “Track Complaint” actions are intended to reduce the number of steps required for common citizen tasks.

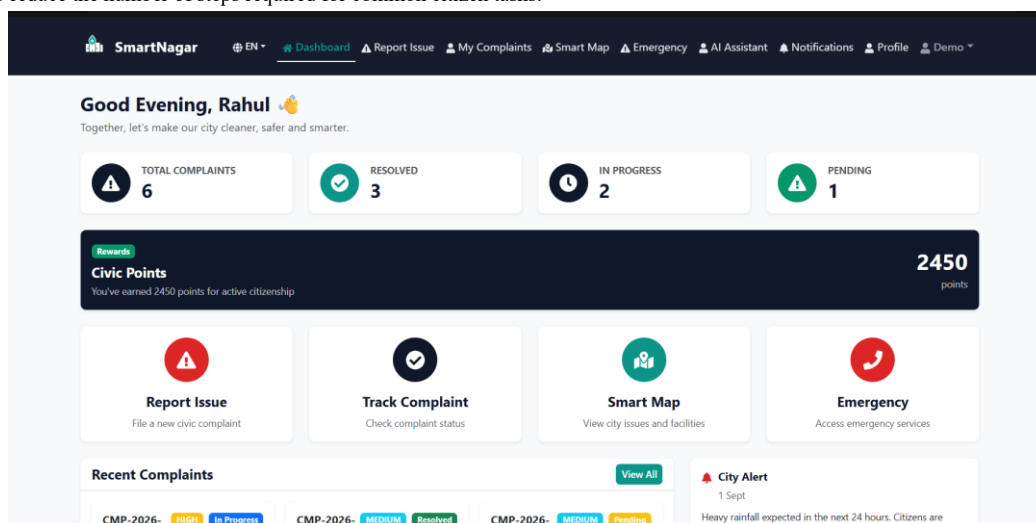


Fig. 3. Citizen dashboard showing complaint summary cards, civic points, quick-service links, recent complaints, and a city alert.

The dashboard brings key complaint information together in one view. Summary cards distinguish total, resolved, in-progress, and pending complaints. Quick-service cards provide shortcuts to report an issue, track a complaint, open the smart map, and access emergency information. The displayed figures and alert are prototype interface examples; they should not be interpreted as live municipal statistics unless connected to a verified backend.

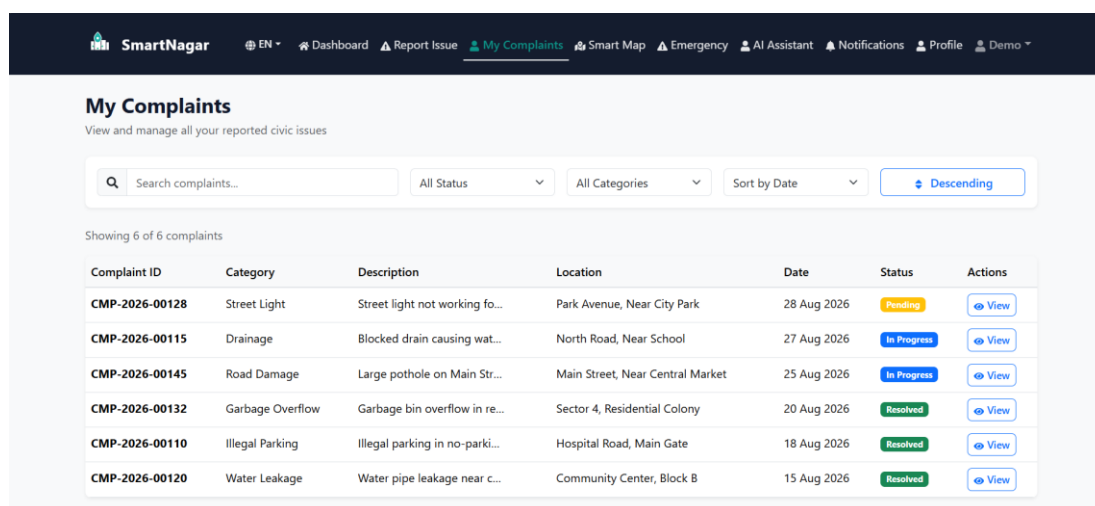
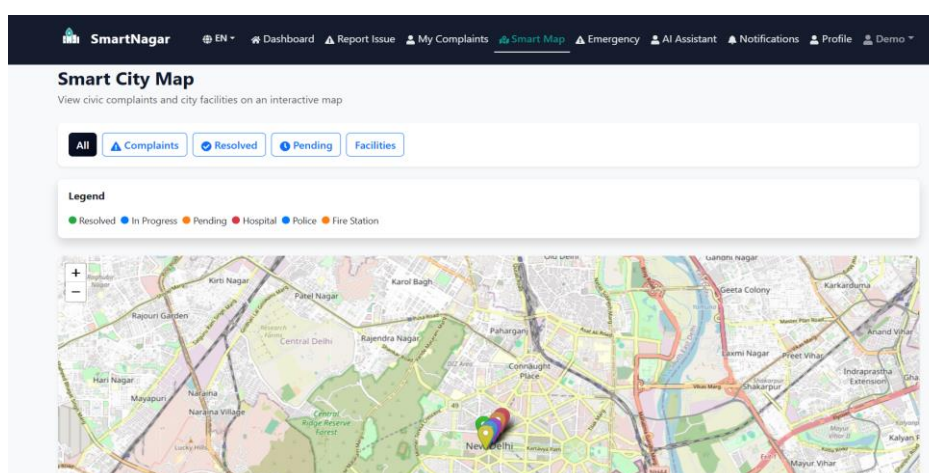


Fig. 4. “My Complaints” page with search, status and category filters, date sorting, and complaint-level actions.

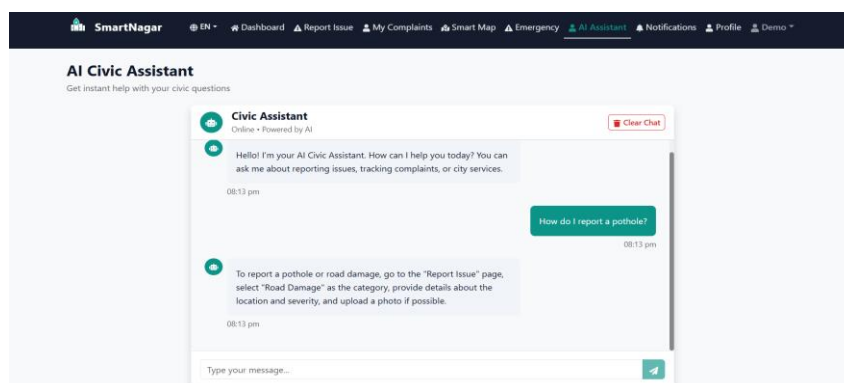
The complaints page presents submitted reports in a tabular format with complaint ID, category, description, location, date, status, and a View action. Search and filters are intended to help citizens locate a report quickly, while status labels make the current stage easier to understand. The shown complaint records are illustrative prototype data.

Fig. 5. Smart Map interface with complaint-status filters, map legend, and geographic markers.



The Smart Map interface is designed to provide geographic context for civic issues and public facilities. Filter controls allow users to focus on all items, complaints, resolved cases, pending cases, or facilities. A legend explains marker categories. For operational deployment, map markers should be generated from validated complaint coordinates and facility records, with location accuracy and privacy safeguards considered.

Fig. 6. AI Civic Assistant chat interface showing a sample question and guidance for reporting a pothole.



The AI Civic Assistant provides a conversational entry point for common civic-service questions. In the example shown, the user asks how to report a pothole and receives guidance to open the Report Issue page, select Road Damage, describe the location and severity, and attach a photograph if

available. This screenshot demonstrates the chat interface and sample response flow; it does not by itself establish that a live AI model or external language-model API is connected.

X. RESULTS AND DISCUSSION

The reviewed literature provides evidence that the individual building blocks of the proposed portal are feasible and independently studied. Examples include high-performing image classifiers for civic categories, semantic clustering for repeated complaints, 311-style chatbot systems, and predictive maintenance approaches. The review's principal result is architectural rather than a measured performance result for the proposed portal: integration of these capabilities into one citizen-driven pipeline remains comparatively underexplored.

No project-specific accuracy, response-time, usability, dataset-size or end-to-end testing measurements are supplied in the literature-review document. Such values should be reported only after testing the implemented system.

A. Proposed Evaluation Metrics

The image classifier can be evaluated using precision, recall, F1-score and a confusion matrix for each complaint category; accuracy alone may hide weak performance on less frequent categories. Duplicate detection can be evaluated using precision and recall on a manually reviewed set of complaint pairs. If the system assigns priority levels, the team should report the agreement between model suggestions and verified labels. Operational evaluation can measure median and 95th-percentile submission response time, successful submission rate, time from submission to acknowledgement, time to assignment and time to resolution. Usability can be assessed through task-completion rate and feedback from a small, clearly described participant group.

B. Results Reporting Plan

A final experimental section should identify the dataset source, number of samples, category distribution, train-validation-test split, hardware or runtime environment, model configuration and evaluation procedure. Results should be shown in tables with the metric definition and the number of evaluated examples. Baseline results should be compared with the proposed method where possible. Any pilot study should report its location, duration and limitations. Since the supplied paper contains no measurements from a completed Smart Nagar implementation, this section defines an evaluation plan and does not present invented scores or claim a measured improvement.

C. Expected Benefits and Evidence Required

The expected benefits are a more traceable complaint process, reduced manual sorting, improved visibility of repeated issues and better use of complaint history for planning. To establish these benefits, the team would need to compare the workflow before and after deployment or conduct a controlled pilot. Evidence could include the proportion of reports correctly categorised, duplicate recommendations accepted by administrators, citizen satisfaction, assignment delays and closure times. A reduction in processing time or an increase in satisfaction should only be claimed if supported by collected data.

D. Observations from the Prototype Screens

The supplied screenshots provide interface-level evidence for five major user-facing areas: the landing page, citizen dashboard, complaint list, geographic map, and AI assistant. Across these screens, the prototype demonstrates a consistent navigation bar and a common visual language for civic actions and complaint status. The complaint list includes search, filtering, sorting, and a View action; the dashboard summarises complaint states; and the map screen groups map items using filters and a legend. These are observations of the visible interface, not measurements of backend performance.

The screenshots do not verify database persistence, authentication security, live GPS acquisition, actual map-data freshness, AI model accuracy, API response time, or successful end-to-end complaint resolution. These capabilities should be tested separately and reported with reproducible evidence. A suitable next test cycle would submit a new complaint, confirm that it receives a unique ID, verify that it appears in My Complaints and on the map when coordinates are available, update its status through the assigned workflow, and confirm that the dashboard counts change consistently.

Table I. Prototype feature evidence and further validation required

XI. ADVANTAGES AND LIMITATIONS

Advantages: The proposed integration can reduce fragmentation between reporting and processing; support photo/GPS-based reporting; assist classification and duplicate handling; provide conversational support; and use complaint history for hotspot/trend analysis.

Limitations: The reviewed reporting literature identifies risks including spam or fake reports, slow government response, privacy exposure, low sustained engagement and resistance to transparency. The proposed system also depends on the quality of citizen-submitted data and the effectiveness of its AI/NLP models. IoT integration is identified as future scope rather than a currently established component in the supplied material.

Privacy, Security and Responsible Use

Photographs and GPS coordinates may reveal a person's location, home, vehicle or other identifying details. The portal should collect only information needed to process a complaint, explain why location access is requested and provide a clear privacy notice. Access to contact details should be restricted to authorised roles, and administrative actions should be logged. Uploaded files should be validated and protected from unauthorised access. Retention and deletion rules should be defined for complaint records and attachments. Public maps or dashboards should avoid exposing personal contact information and should consider reducing location precision where exact coordinates are not needed.

Fairness and accountability also matter. Reports from areas with better connectivity or higher digital literacy may be more numerous than reports from underserved neighbourhoods. Complaint counts should therefore not be interpreted as a complete measure of civic need. Administrators should have a way to correct model predictions and review complaints that are repeatedly misclassified. The portal should not automatically reject a complaint solely because an AI model assigns a low confidence score, and important decisions should remain reviewable by a responsible human.

XII. FUTURE SCOPE

The literature review identifies several extensions, including stronger predictive analytics, broader IoT integration, privacy-preserving federated learning for municipal sensors, and continued development of citizen-facing chatbot and automation capabilities. In the proposed project mapping, IoT is explicitly treated as future scope, while hotspot/trend analytics are based on complaint history.

Additional Research Directions

Further work may examine multilingual complaint submission, including support for Marathi, Hindi and English, because residents may describe the same problem in different languages. A multilingual workflow would require suitable examples, language-aware text processing and human review of uncertain translations. Another direction is an accessibility-focused interface with readable status messages, keyboard navigation and support for users with limited digital experience. Integration with existing municipal ticketing systems could reduce duplicate data entry, but would require agreement on identifiers, status definitions and data-sharing permissions.

Longitudinal analysis could investigate whether recurring complaints are associated with particular locations, seasons or infrastructure types. Such analysis should distinguish correlation from causation and should be validated with municipal records or field inspection. Future studies could also compare rule-based routing with AI-assisted routing, measure the effect of duplicate recommendations on staff workload, and assess whether public status dashboards improve trust. These are research directions rather than capabilities claimed as completed in the present paper.

XIII. CONCLUSION

The literature confirms that crowdsourced reporting, image-based civic-issue classification, NLP-driven duplicate detection and chat support, and predictive hotspot analytics are each independently well studied. The principal research gap is their integration into a single end-to-end platform in which a citizen's photo-and-location report is automatically classified, checked against nearby duplicates, routed to a worker and incorporated into city-wide predictive analysis. The proposed Smart Nagar Citizen Portal therefore represents a synthesis of established techniques into an integrated civic-management workflow, with feasibility precedents for each major stage.

The contribution of the Smart Nagar concept is therefore its integrated workflow and the proposed evaluation framework connecting citizen reports with administrative action and feedback. The paper also highlights that integration alone is not sufficient: reliability, privacy, human oversight, inclusion and transparent evaluation must be addressed before the platform can be considered effective in practice.

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Feature	Visible evidence	Further validation required
Home page	Navigation and Report/Track actions	Verify links, responsive layout, and form navigation
Dashboard	Complaint summary cards and quick-service cards	Check counts against stored complaint records
My Complaints	Search, filters, sorting, status labels, View action	Test query correctness, access control, and status updates
Smart Map	Filters, legend, map markers	Validate coordinates, map-data source, and marker filtering
AI Assistant	Chat panel and sample pothole guidance	Test answer quality, fallback handling, safety, and whether a live AI service is connected