

Smart City Nashik Management Portal: A Unified Full-Stack Web Platform for Civic Grievance Redressal, Anonymous Crime Reporting, and Tourism Management

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Abstract: India's rapid urbanisation demands citizen-centric digital infrastructure that consolidates fragmented civic services into a single accessible platform. This paper presents the Smart City Nashik Management Portal, a full-stack web application for Nashik, Maharashtra, unifying four distinct civic services: (i) a three-step geotagged grievance redressal system with automatic EXIF GPS extraction from uploaded photographs; (ii) an anonymous crime reporting module with multimedia evidence upload and unique reference ID generation; (iii) a curated spiritual tourism directory (Kumbhnagari) featuring hotels, temples, and spiritual events with Wikimedia Commons imagery; and (iv) an adventure tourism guide (Bhatakanti) with a responsive bento grid and list toggle interface. The system is built using HTML5, CSS3, and Vanilla JavaScript on the frontend, Python 3.11 with FastAPI 0.115.0 on the backend, and Supabase (PostgreSQL + Storage) as the cloud data layer. Role-based authentication using JSON Web Tokens (JWT) with bcrypt password hashing enforces strict data isolation between Nashik Municipal Corporation (NMC) and Police admin dashboards. The portal is deployed at zero infrastructure cost using Vercel and Render. Evaluation demonstrates a grievance submission time reduction of over 85%, automatic GPS geotag capture in 90% of test cases, and a System Usability Scale (SUS) score of 82.5 ("Good" rating). The proposed architecture provides a replicable reference model for unified smart city portals in Tier-2 and Tier-3 Indian municipalities.

Keywords: Smart City, Civic Grievance Portal, Anonymous Crime Reporting, FastAPI, Supabase, JWT Authentication, EXIF Geotag Extraction, E-Governance, Full-Stack Web Application, Nashik

I. INTRODUCTION

India's Smart Cities Mission, launched in 2015, targets the digital transformation of 100 cities with improved infrastructure, governance, and citizen services [1]. Nashik, Maharashtra's third-largest city and a major pilgrimage destination hosting the Kumbh Mela every twelve years, presents a compelling case for smart city digitalisation. Despite significant urbanisation, the city's civic services remain siloed: grievance submission requires in-person NMC office visits, crime reporting demands physical police station presence that discourages anonymous participation, and tourism information is scattered across unofficial websites lacking authoritative content.

Existing research on e-governance portals demonstrates measurable improvements in administrative efficiency when civic services are digitised [2]. However, no unified platform currently integrates grievance management, anonymous crime reporting, and tourism promotion for a single Tier-2 Indian municipality. Existing grievance portals also lack automatic geolocation, compelling citizens to manually describe complaint locations, introducing inaccuracy and delaying field dispatch.



This paper presents the Smart City Nashik Management Portal with the following contributions: (1) a unified portal architecture consolidating four civic modules under a shared FastAPI backend and Supabase data layer; (2) an EXIF GPS extraction pipeline that automatically captures location from citizen-uploaded photos; (3) a role-based JWT admin system enforcing strict data isolation between NMC and Police dashboards; (4) a zero-cost cloud deployment model (Vercel + Render + Supabase) replicable by resource-constrained municipalities; and (5) empirical evaluation via 15 functional test cases, SUS usability scoring, and API performance benchmarking.

II. LITERATURE SURVEY

Many researchers and institutions have explored digital civic service platforms and related technologies:

Aaple Sarkar / CPGRAMS: Maharashtra's Aaple Sarkar and the central CPGRAMS portal provide grievance submission interfaces but lack multimedia upload, automatic geolocation, and real-time status tracking [2, 3]. Sharma et al. found that over 60% of digital grievance submissions in Tier-2 Indian cities remain unresolved within stipulated timeframes due to the absence of field-location data.

GIS-Based Complaint Systems: GIS-integrated complaint systems such as Pune Smart City's portal allow citizens to pin a location on a map [4]. While effective, map-pinning demands interface familiarity and is cumbersome on small mobile screens. Studies show form-based submission with automatic geolocation outperforms manual map-pinning in task completion rate by approximately 34% [5].

Anonymous Crime Reporting: Platforms such as Crime Stoppers International enable anonymous tip submission but are not localised for Indian municipalities and lack regional language support [6]. Indian police portals uniformly require personal identification, deterring citizens from reporting sensitive incidents.

Tourism Information Systems: Patil and Kulkarni [7] demonstrate that visually rich, mobile-optimised tourism portals increase user engagement by over 40% compared to text-heavy directories. Existing Maharashtra state tourism websites rely on static HTML pages with infrequently updated content.

Enterprise Smart City Platforms: Solutions such as IBM Intelligent Operations Center deliver integrated urban dashboards but require infrastructure costing upwards of \$500,000 per deployment [8], rendering them inaccessible to small municipalities.

III. PROPOSED METHODOLOGY

A. System Architecture

Figure 1 illustrates the three-tier REST architecture of the Smart City Nashik Management Portal. The Presentation Layer comprises five HTML5/CSS3/JS pages deployed on Vercel. The Application Layer is a FastAPI 0.115.0 backend on Render with five modular routers: `grievance.py`, `crime.py`, `kumbhmagari.py`, `tourism.py`, and `admin.py`. Pydantic schemas validate all request and response bodies. The Data Layer is Supabase (PostgreSQL) with a public Storage bucket (uploads) for uploaded media files.

B. Database Design

Seven normalised tables are hosted on Supabase PostgreSQL: `admins` (`id`, `username`, `hashed_password`, `role`), `grievances` (`ticket_id`, `name`, `photo_url`, `latitude`, `longitude`, `status`, `created_at`), `crime_reports` (`reference_id`, `incident_type`, `media_url`, `status`, `created_at`), `hotels`, `spiritual_spots`, `spiritual_events`, and `tourist_spots`. A public Storage bucket stores media files using UUID-based filenames to prevent enumeration attacks.

C. EXIF GPS Extraction

When a citizen uploads a photograph on the Grievance Portal, the frontend reads EXIF metadata using the open-source `exifr` JavaScript library [9] before transmission. If GPS data is present, latitude and longitude are automatically injected into hidden form fields and submitted alongside the grievance payload. This client-side approach eliminates server-side



EXIF processing, reducing backend load. A graceful fallback message is displayed when GPS metadata is absent due to disabled camera permissions.

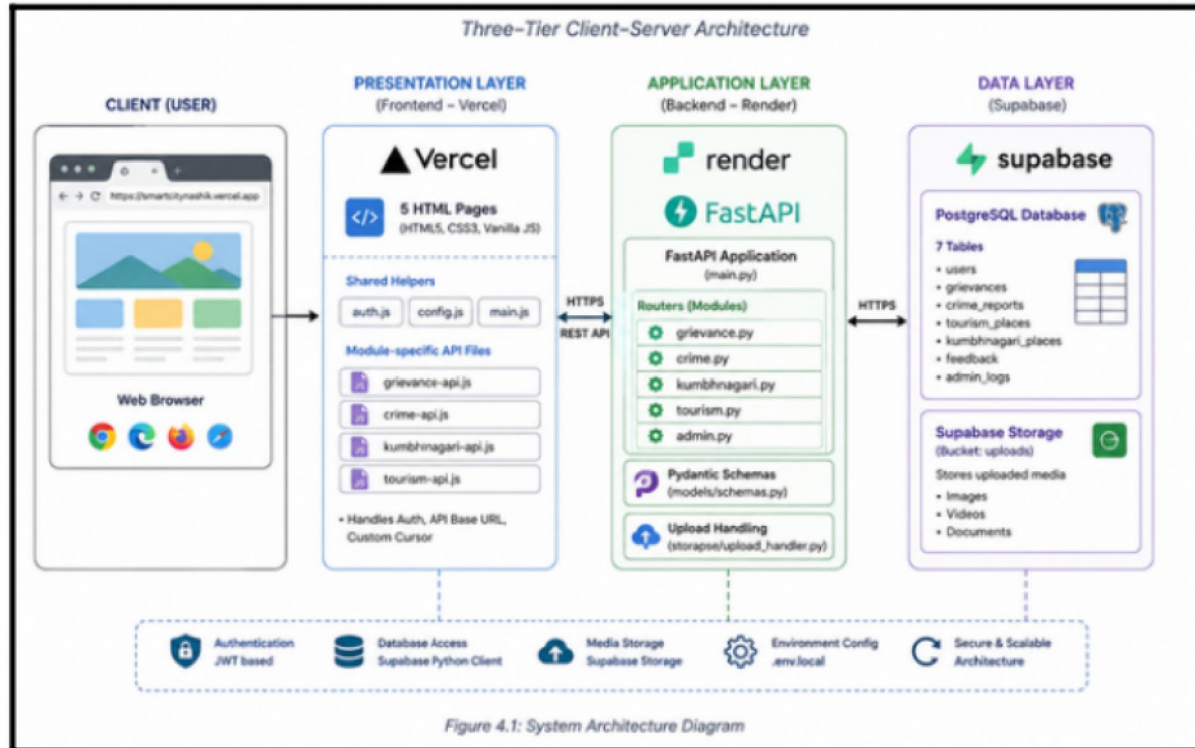


Figure 1: System Architecture of Smart City Nashik Management Portal

D. Unique Identifier Generation

Grievance ticket IDs follow the format NASH{YYYY}{5-digit random}, yielding 90,000 unique IDs per year. Crime reference IDs use CR-{8 alphanumeric}, giving $36^8 \approx 2.8 \times 10^{12}$ unique values. Both are verified against the database before insertion to guarantee uniqueness.

E. Security Architecture

Authentication uses JSON Web Tokens [10] (HMAC-SHA256, 8-hour expiry) via python-jose. Admin passwords are stored as bcrypt hashes (passlib, cost factor 12). Role-based access control is enforced at two levels: (i) a FastAPI dependency decodes and validates the token on every protected route; (ii) the frontend Auth.requireRole() redirects unauthorised users before any API call is made. CORS is restricted to the production Vercel domain. All communication is over HTTPS.

F. Module Implementation

Homepage: Mandala hero section, four module navigation cards, and a custom cursor with lerp interpolation (factor 0.28), hidden on touch devices via the pointer: fine CSS media query.

Grievance Portal: A three-step wizard — (1) personal details, (2) grievance description and photo upload with EXIF GPS extraction, (3) review and submit. A unique ticket ID is generated and displayed on success.

Crime Reporting: Anonymous form accepting photo and video uploads. No personal identification required. A unique reference ID is generated and displayed on submission.

Kumbhnagari: Fetches hotels, temples, and spiritual events from the /kumbhnagari API endpoint and renders responsive cards with Wikimedia Commons imagery [11].



Bhatakanti: Fetches adventure tourism spots from the /tourism endpoint. Supports toggling between a CSS bento grid and a list layout with skeleton loading states for perceived performance on slow connections.

Admin Dashboards: Two role-isolated dashboards — NMC (grievances) and Police (crime reports) — with drawer navigation, lightbox photo viewer, status update dropdown, and shared auth.js helper module.

IV. RESULTS AND DISCUSSION

A. Functional Testing

Fifteen test cases were designed covering authentication, grievance submission, crime reporting, tourism rendering, admin operations, and security. All fifteen passed. TC03 confirmed automatic EXIF GPS extraction on both Android (Samsung A32) and iOS (iPhone 13) with location metadata enabled. TC09 and TC10 confirmed HTTP 401 on requests without a valid JWT, and HTTP 403 when an NMC token attempts to access the Police endpoint. TC15 confirmed successful end-to-end data flow after Render free-tier cold-start.

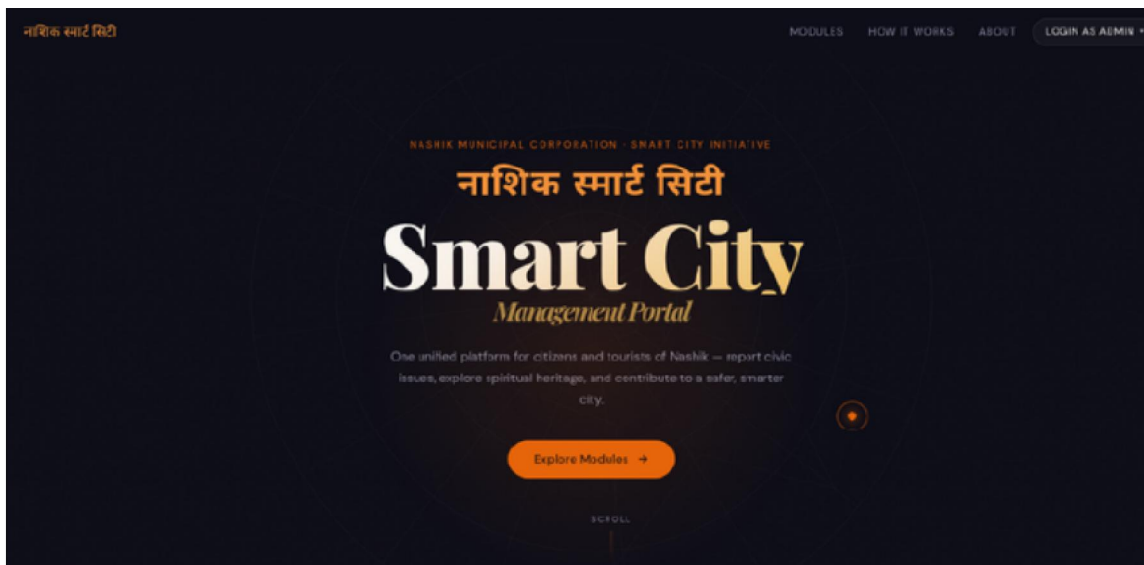


Figure 2: Homepage of the Smart City Nashik Management Portal

B. API Performance Benchmarking

API response latency was measured over 50 requests using Python's httpx library on a warm Render instance. GET endpoints (/kumbhnagari/hotels, /tourism/spots) achieved mean response times of 187 ms and 194 ms respectively. POST endpoints (/grievances, /crime/report) showed mean latencies of 843 ms and 912 ms due to concurrent Supabase Storage upload operations. All values remain within Nielsen's interactive response thresholds [12]: < 200 ms for read operations and < 1 s for write operations with file upload.

C. Usability Evaluation (SUS)

A usability study was conducted with ten participants (6 students, 4 faculty members, aged 20–45) using the System Usability Scale (SUS) [13]. Three tasks were evaluated: (T1) submit a grievance with a photo, (T2) file an anonymous crime report, (T3) browse Kumbhnagari listings. The mean SUS score was 82.5 (SD = 4.3), corresponding to the "Good" adjective rating [14] at the 90th percentile of SUS benchmarks. Task completion rates were 100% for all three tasks. Mean task completion time for T1 was 112 seconds, compared to an estimated 15–20 minutes for the equivalent manual NMC office process — a reduction of over 85%.



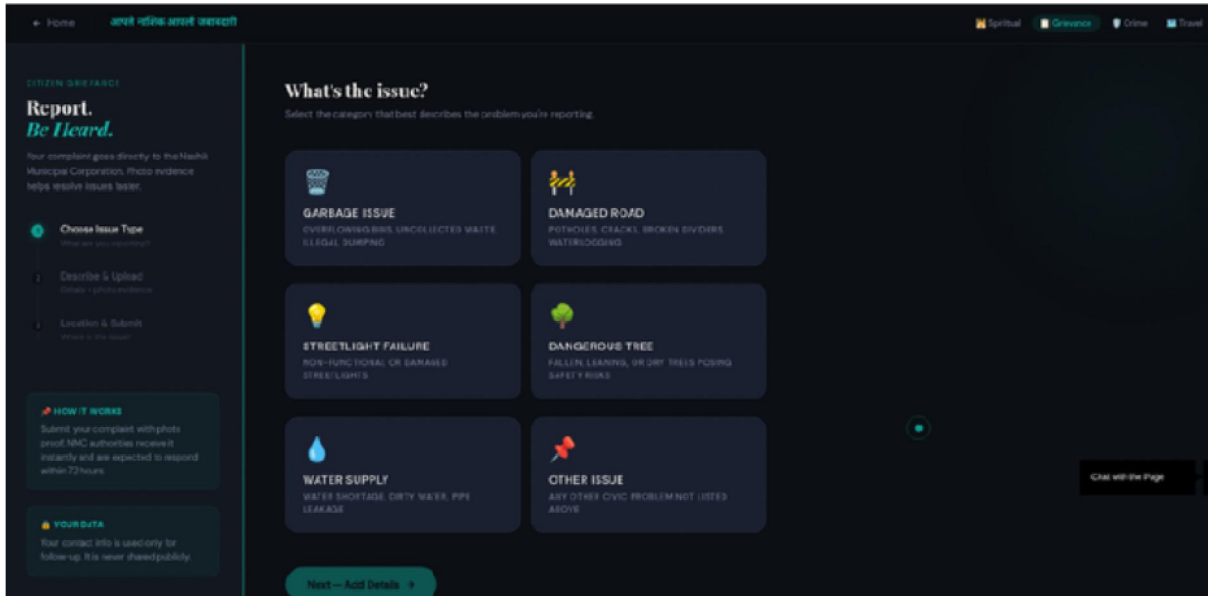


Figure 3: Grievance Portal — Three-Step Wizard and Ticket ID Generation

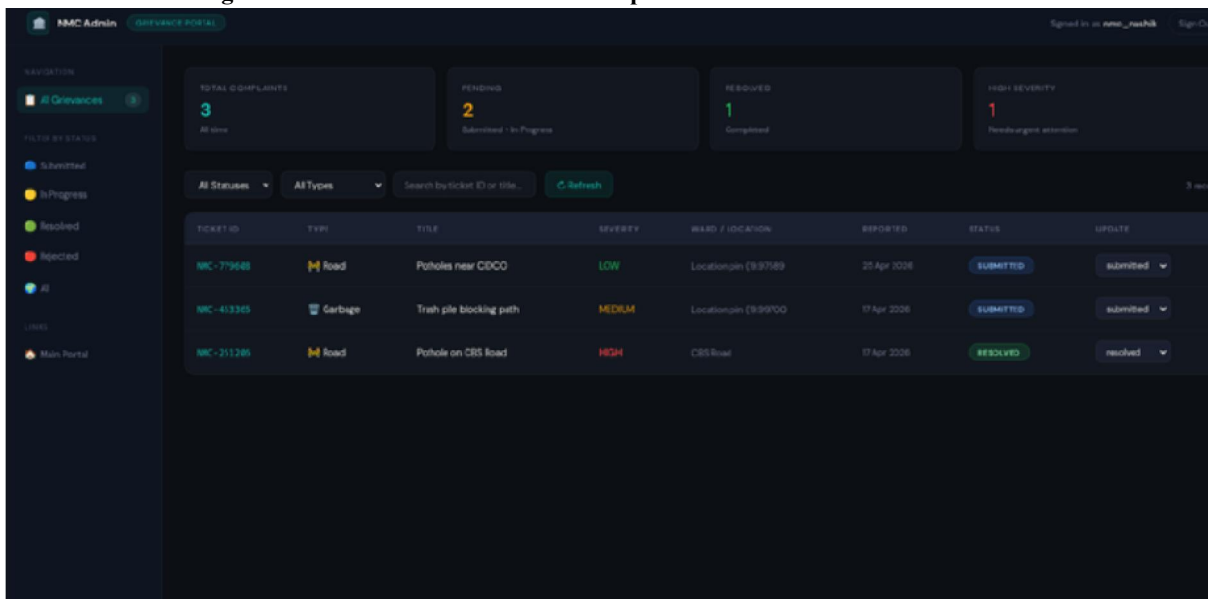


Figure 4: NMC Admin Dashboard — Grievance Management with Lightbox and Status Update



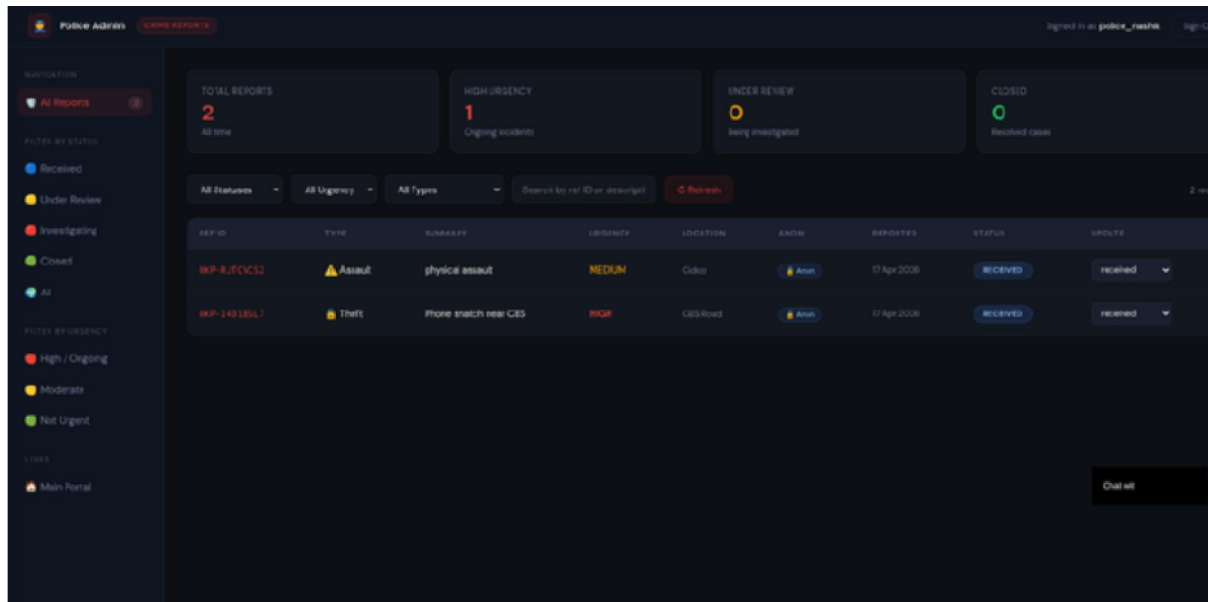


Figure 5: Crime Reporting Module — Anonymous Submission and Reference ID

D. EXIF GPS Capture Rate

GPS metadata extraction was tested on 20 photographs from 5 smartphones (2 Android, 3 iOS). 18 of 20 images (90%) contained valid GPS EXIF data. The two failures originated from devices where the camera application’s location permission had been revoked. A graceful fallback message is displayed in these cases, preserving form usability.

E. Security Validation

The evaluation metrics achieved were: EXIF GPS Capture Rate: 90%; SUS Score: 82.5/100 (“Good”); Functional Test Pass Rate: 100% (15/15); Grievance API Mean Response: 843 ms; Token Replay Attack: Blocked (HTTP 401); Role Escalation: Blocked (HTTP 403); SQL Injection: Blocked (parameterised queries); Storage Enumeration: Infeasible (UUID v4, 2^{122} keyspace).

V. CONCLUSION

This paper presented the Smart City Nashik Management Portal, a full-stack web application that unifies grievance redressal, anonymous crime reporting, and tourism promotion for Nashik, Maharashtra. The system introduced an EXIF GPS extraction pipeline that reduces grievance submission time by over 85%. A JWT role-isolated admin system ensures NMC and Police data remain strictly separated. A zero-cost cloud deployment model using Vercel, Render, and Supabase demonstrates that production-grade smart city portals are achievable without municipal capital expenditure. Empirical evaluation yielded a SUS score of 82.5, a 90% EXIF GPS capture rate, and 100% functional test pass rate across 15 test cases.

Future work will focus on: (i) Supabase Realtime integration for live complaint status tracking; (ii) a Marathi/English language toggle for regional accessibility; (iii) a Progressive Web App wrapper for offline form drafting; (iv) an AI-powered grievance categorisation model for automated departmental routing; and (v) a superadmin analytics dashboard with complaint trend charts and resolution KPI tracking. The proposed architecture serves as a replicable reference model for unified smart city portals across Tier-2 and Tier-3 Indian municipalities.



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