ZONEFIX: AI-POWERED DETECTION AND RESOLUTION OF URBAN INFRASTRUCTURE ISSUES

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College   :   R V College of Engineering, Bengaluru
Branch   :   Department of Information Technology
Guide(s)   :   Dr. Mamatha G S
Student(s) :   Mr. Ravish S H

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Introduction:

Urban governance in Indian cities often suffers from delays, inefficiency, and poor accountability in resolving civic issues such as potholes, garbage collection, drainage, and streetlight faults. Citizens face a lack of transparency and responsiveness from authorities, while corporators and municipal administrators struggle with manual workflows and limited decision-making tools.

ZoneFix is designed to address these issues through an intelligent, AI-powered complaint management system tailored for corporators and administrators. It replaces traditional paperwork and fragmented systems with real-time dashboards, role-based access, and automated image-based severity classification using deep learning. The platform ensures transparency, faster resolution cycles, and measurable corporator performance tracking.

3Objectives:

•   Develop a web-based platform that allows corporators and municipal authorities to manage civic complaints efficiently using role-based access.

•   Integrate a learning model to analyze complaint images and automatically classify damage severity into Low, Medium, or High levels.

• Use AI-generated severity levels to triage and prioritize critical complaints, enabling faster and smarter resolution workflows.

• Leverage Firebase Realtime Database to ensure instant updates on complaint status, approval stages, and communication between corporators and Admins.

• Implement dashboards for administrators to monitor corporator performance, generate analytics, and promote accountability in urban governance.

Methodology:

1. Setting Up the System & Backend Integration

➢ Configure Firebase Real-Time Database for complaint storage.

➢ Develop a Django backend with Firebase integration.

➢ Implement role-based authentication for corporators and administrators.

2. Developing the Complaint Management Portal

➢ Design a dashboard for corporators to view, analyze, and manage complaints.

➢ Enable administrators to review complaints, allocate resources, and approve budgets

3. AI Integration

➢ Trained a CNN-based severity classification model using EfficientNet-B3 and deployed it as a REST API using Flask.

➢ Integrated the AI model with the Django backend to automatically assign severity levels (Low, Medium, High) for each complaint image.

4. Performance Tracking

➢ Developed real-time dashboards for corporators and admins to monitor complaint status, resolution time, and severity distribution.

➤ Implemented corporator leaderboards and ward-wise analytics to enhance transparency and accountability.
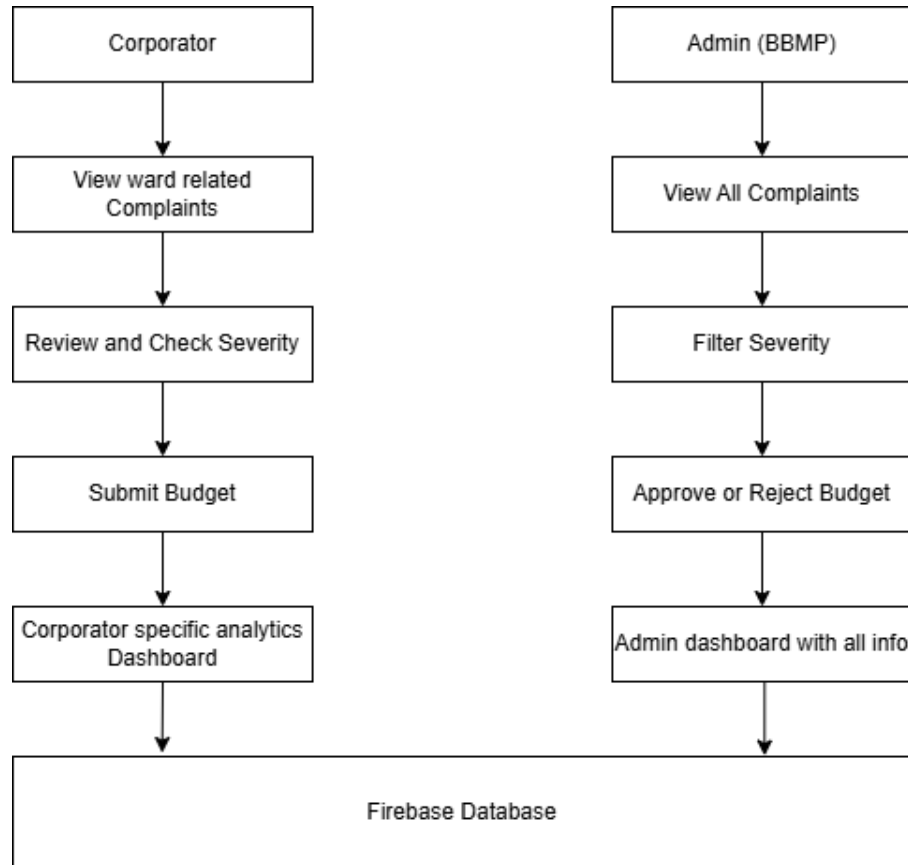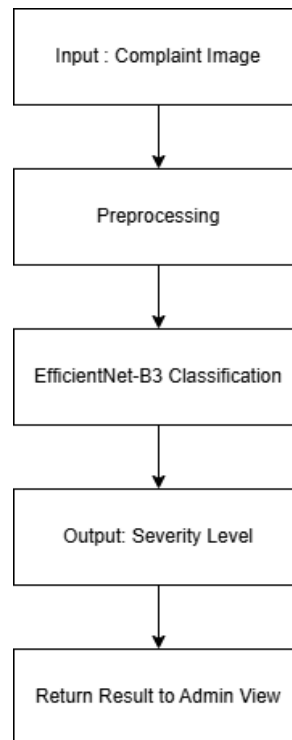

Fig.1 Functionality of Admin and Corporator.

Fig. 2 AI module for ZoneFix

Results & Conclusions:

ZoneFix is a web-based civic complaint management system designed to streamline the resolution of civic issues and enhance transparency in municipal governance. The platform provides secure access through a user-friendly login page.
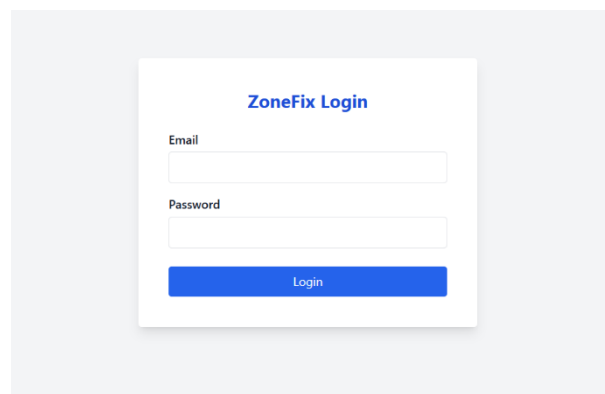

Fig 3. Login Page

Upon logging in, municipal administrators access a comprehensive admin dashboard. This dashboard displays all complaints, categorized by severity and status, allowing administrators to monitor and efficiently manage issues across different wards.
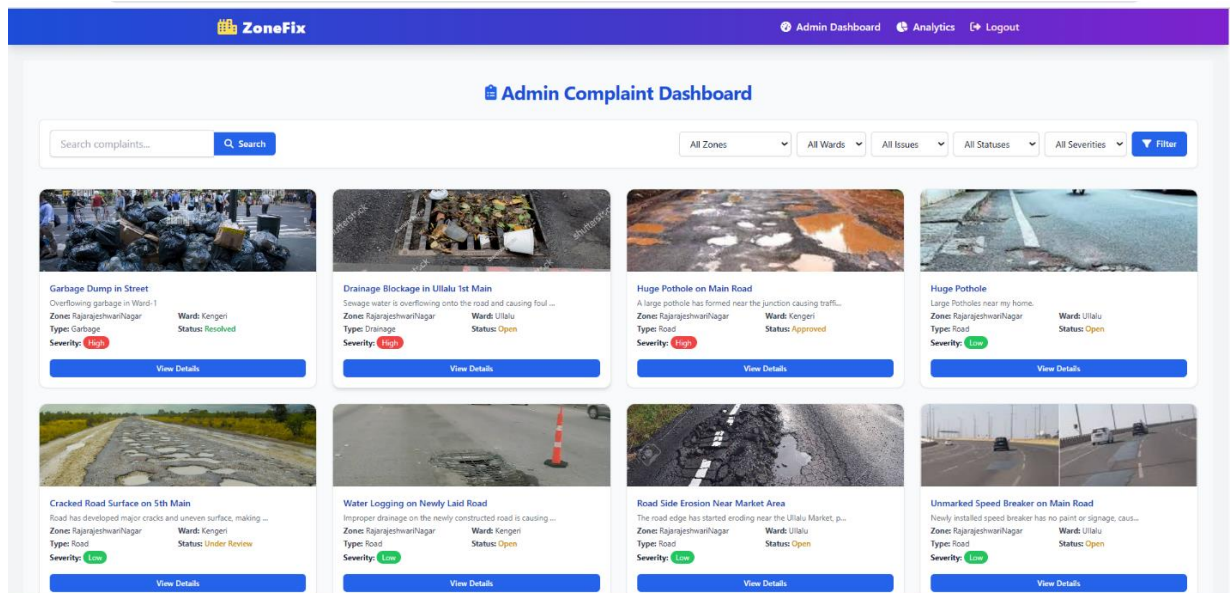
Fig 4. Admin Dashboard

Administrators can further analyse complaint resolution performance through the integrated admin analytics page, which visualizes data such as resolution rates, complaint distributions by severity, and overall corporator responsiveness.
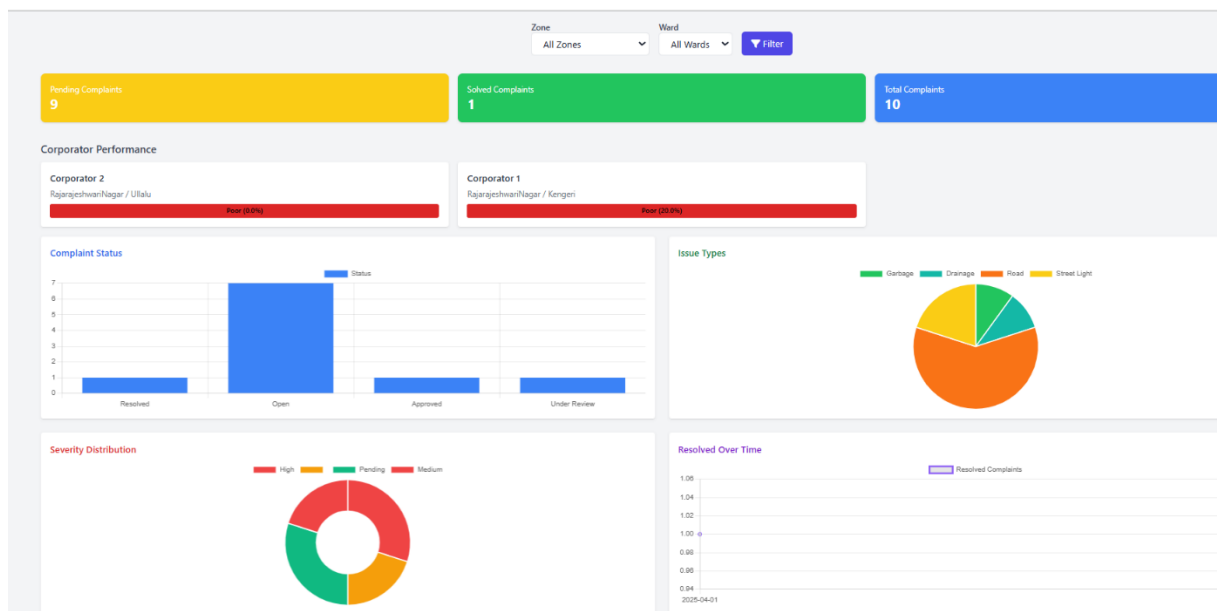

Fig 5. Admin analytics dashboard

Corporators have their own dedicated interface, the corporator dashboard, enabling them to view, verify, and manage complaints specific to their wards. It supports real-

time complaint tracking, budget assignment, and seamless communication with administrators.
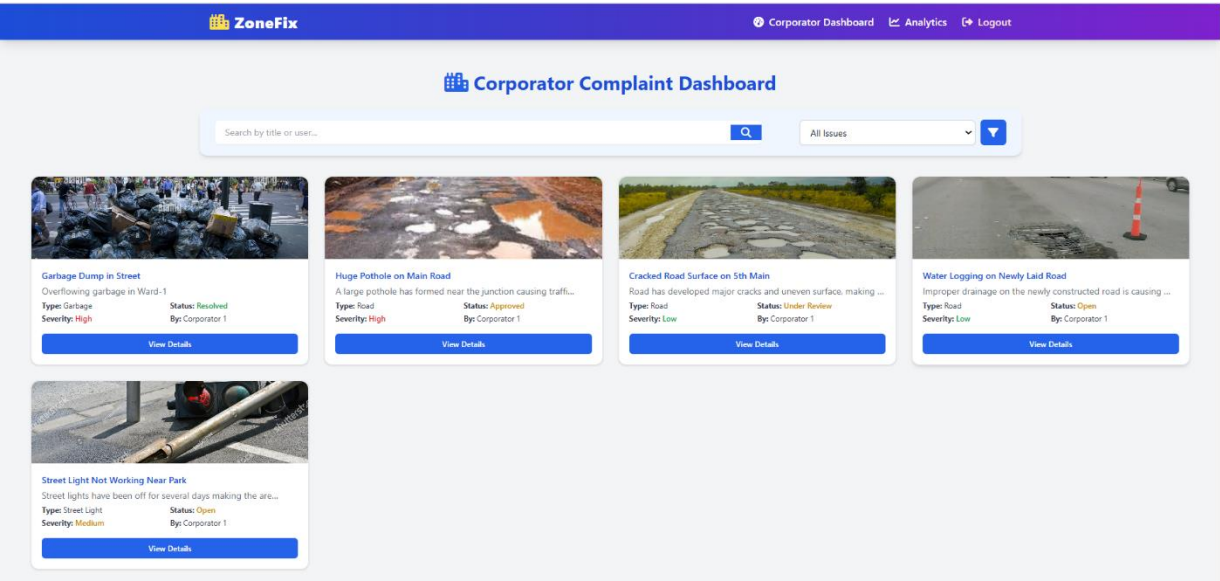

Fig 6. Corporator Dashboard

Selecting a specific complaint opens the detailed complaint detail page, which clearly outlines the issue description, severity (automatically classified by an integrated AI model), budget estimation, complaint history, and current status.
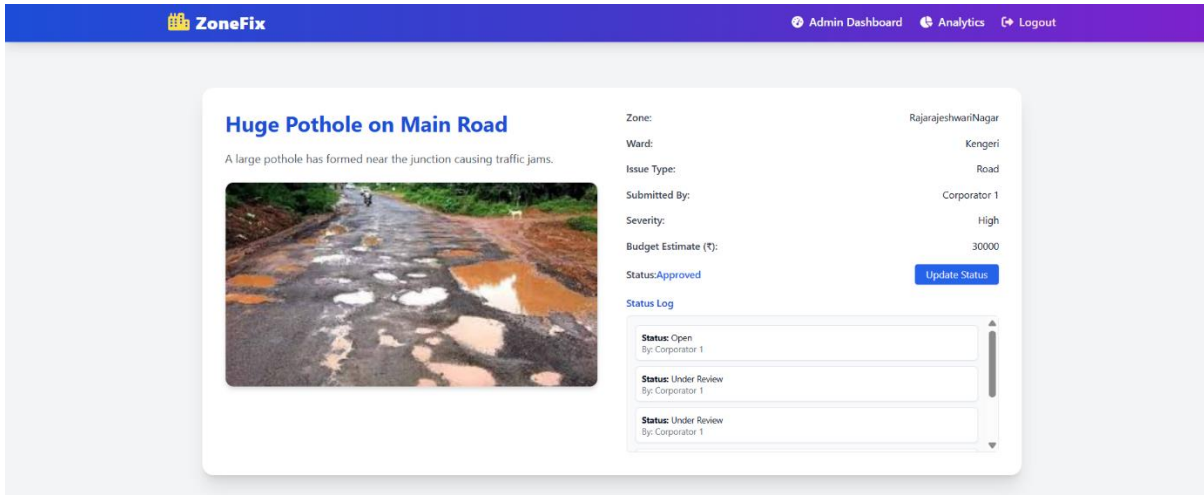

Fig 7. Complaint Detail page

Corporators can also leverage the corporator analytics page to assess their own performance, monitor complaint trends within their wards, and track resolution efficiency through visual analytics.
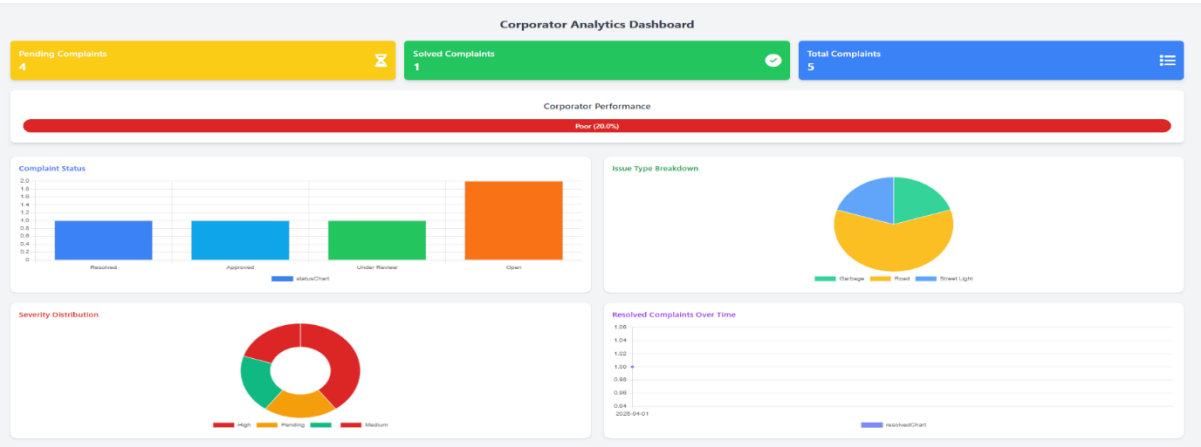

Fig 7. Corporator Dashboard

The highlight of ZoneFix is its built-in AI-based severity detection module, leveraging a PyTorch-trained EfficientNet-B3 deep learning model. This model automatically analyses uploaded images of civic issues—especially road damages—to classify their severity into Low, Medium, or High. This automated prioritization significantly accelerates decision-making and resolution processes.

Overall, ZoneFix aligns closely with smart city objectives, is scalable for larger deployments, and promises substantial improvements in urban infrastructure management.
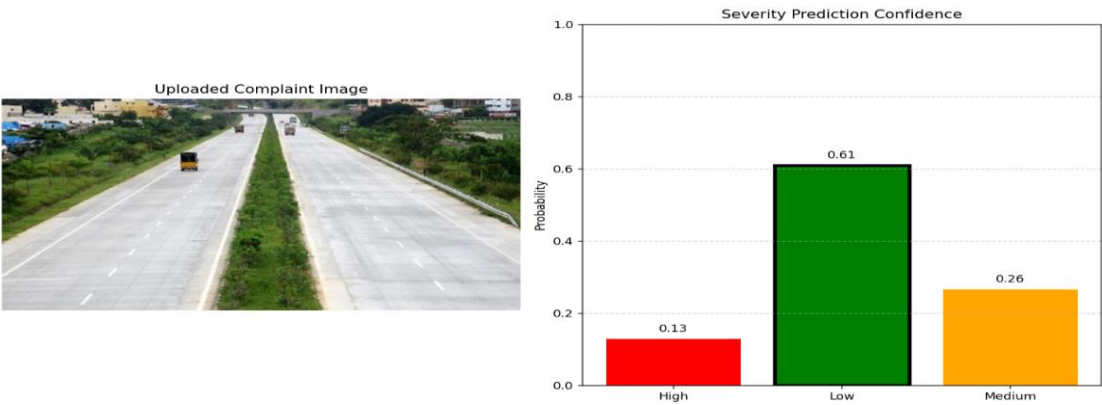
AI severity classification of roads
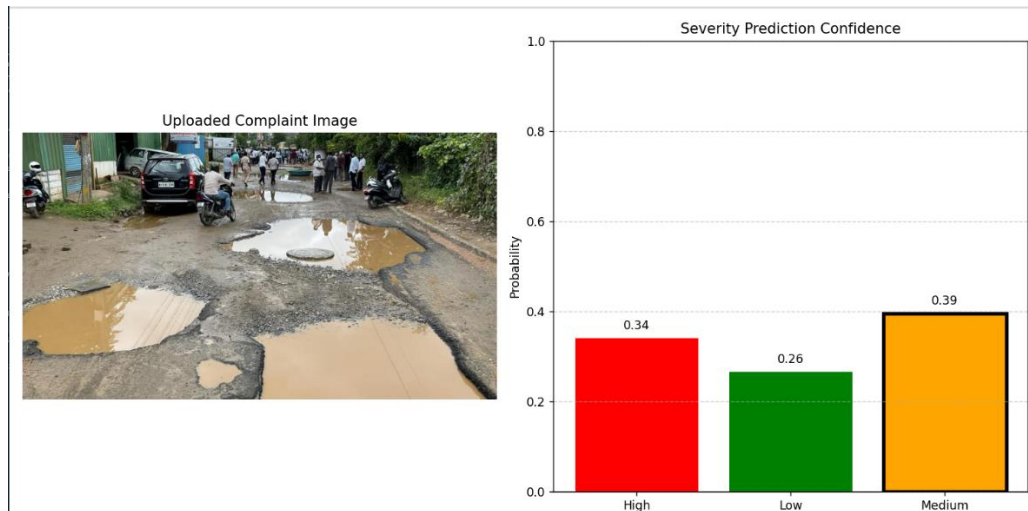

Fig 8. Low Severity Road damage

Fig 9. Medium Severity Road damage
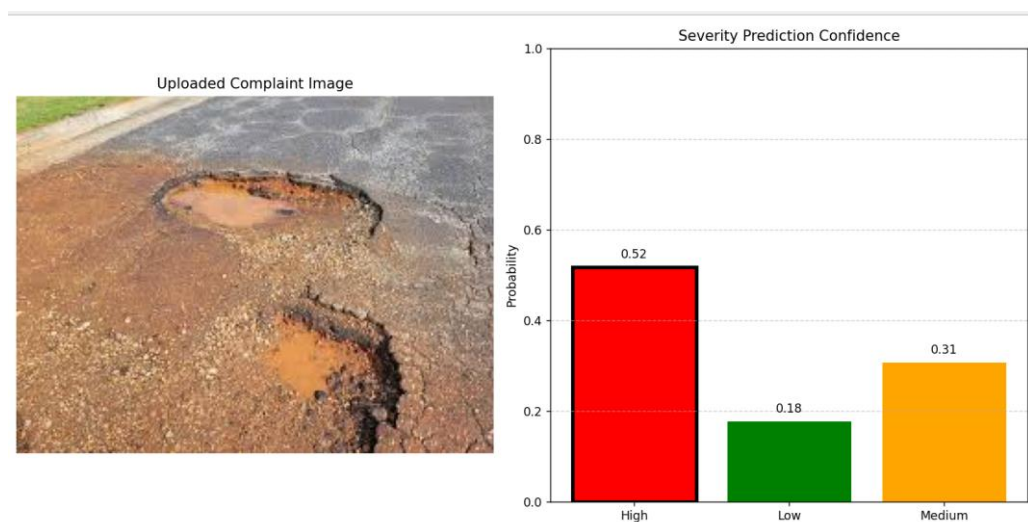
Fig 10. HighSeverity Road damage

Project Outcome & Industry Relevance:

The ZoneFix project has resulted in the development of a fully functional, AI-integrated civic complaint management platform. It offers real-time dashboards for corporators and administrators to efficiently manage, track, and resolve urban infrastructure issues. By leveraging technologies like Django, Firebase, and PyTorch, the system ensures role-based access, live complaint updates, and automatic image-based severity classification. The integration of an AI model trained on real-world civic

issue images allows for accurate triaging, making the resolution process faster and more data-driven.

ZoneFix introduces a performance-driven governance model through interactive dashboards, analytics, and corporator leaderboards. These features not only support transparent monitoring but also motivate ward-level representatives to resolve complaints more efficiently. The end-to-end digitization of complaint workflows—from submission to resolution—improves accountability and provides administrators with valuable insights for resource allocation and ward performance evaluation. The system's modularity ensures that it can be scaled to support multiple zones or cities with minimal adjustments.

From an industry relevance standpoint, ZoneFix aligns perfectly with initiatives like the Smart Cities Mission and digital municipal reforms. It can be readily adopted by urban local bodies such as BBMP (Bengaluru), and integrated into existing public grievance redressal systems. There is strong potential for collaboration with civic-tech startups, government partners, or NGOs seeking technology-driven civic engagement solutions. Its AI-driven approach not only improves service delivery but also reduces administrative burden and promotes trust among citizens—making it a highly scalable and impactful solution for future urban governance.

Working Model vs. Simulation/Study:

ZoneFix is developing as a fully functional working model, not a simulation or theoretical study. The system includes live, interactive web-based dashboards for both corporators and administrators, connected via Firebase Realtime Database to ensure instant status synchronization of complaints. The AI model used for severity classification has been trained, deployed, and integrated into the backend using a REST API, enabling real-time analysis of complaint images.

All modules—complaint status tracking, AI-based triaging, role-based workflow management, and performance analytics—have been implemented and tested in a development environment. The project delivers an end-to-end operational prototype capable of being deployed at ward or city levels. Each feature was built, tested, and validated using actual civic issue data and real-time sync mechanisms, confirming that this is a live product rather than a conceptual or simulated implementation.

Project Outcomes and Learnings:

The development of ZoneFix led to several significant outcomes, both technical and practical. One of the primary accomplishments was the successful integration of a deep learning model (EfficientNet-B3) with a real-time web application, enabling automated classification of complaint images into severity levels. Additionally, the implementation of role-based dashboards using Django and Firebase allowed corporators and administrators to collaborate effectively on resolving complaints, with real-time data updates and status tracking.

Throughout the project, various skills were gained in the areas of full-stack web development, RESTful API design, real-time database integration, and AI model deployment. The team learned how to train and fine-tune machine learning models for real-world civic issues, improve data accuracy through custom dataset creation, and apply frontend design principles to ensure usability for administrative roles.

Beyond technical proficiency, the project also strengthened critical thinking and problem-solving abilities by dealing with practical challenges like sync delays, dataset limitations, and workflow design. Overall, ZoneFix served as a hands-on learning experience in building scalable, socially impactful technology for urban governance, combining AI, cloud technologies, and real-time collaboration.

Future Scope:

The future scope of ZoneFix includes several technical enhancements and strategic expansions. One major improvement is the integration of a citizen-facing Android application with multilingual and chatbot-based complaint submission features. This would allow citizens to directly interact with the platform while retaining the core workflow handled by corporators and administrators. The system can also be extended to support additional complaint types like electricity faults, water supply issues, or traffic signal failures.

Technologically, the AI model can be further trained using a larger and more diverse dataset, allowing it to detect multiple issues within a single image using object detection techniques. Predictive analytics could be introduced to forecast recurring complaints in specific areas, helping city planners allocate budgets proactively.

Moreover, incorporating blockchain for complaint logging could provide immutable audit trails and improve public trust in the complaint handling process.

From a deployment perspective, ZoneFix is well-suited for collaboration with municipal corporations, Smart City initiatives, and civic-tech organizations. The platform's modular architecture ensures easy replication across cities and wards. In the long term, efforts will be made to seek funding or incubation support to scale the platform commercially. The team also plans to explore filing for Intellectual Property Rights (IPR) for the AI integration workflow and dashboard logic to protect the innovation and facilitate potential commercialization.