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CivicFix: Smart Complaint Routing for Urban Solutions

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Abstract: Urban infrastructure maintenance is often hindered by inefficient complaint reporting systems, leading to delays in addressing critical public issues such as potholes, garbage accu- mulation, broken streetlights, and drainage problems. CivicFix is a cloud-based digital complaint system designed to simplify and automate the grievance redressal process. The platform allows users to report issues by uploading an image, while Google Maps API fetches the location details automatically. A machine learning model then classifies the complaint into categories such as potholes, garbage, streetlights, or drainage, ensuring that it is routed to the appropriate municipal department for resolution. The system features separate dashboards and logins for both users and department officers, allowing users to track complaint statuses and enabling authorities to efficiently manage and resolve issues. Additionally, a public voting mechanism prioritizes urgent complaints, ensuring quicker responses to high-impact problems. By leveraging cloud storage, AI-based classification, and automated routing, CivicFix enhances urban governance, making issue reporting more efficient, transparent, and community-driven.

Index Terms: Smart city, urban infrastructure, complaint redressal system, AI-based classification, Google Maps API, cloud computing, Firebase, Web-Based Application, Smart Governance

I. INTRODUCTION

Maintaining public infrastructure is a crucial aspect of urban governance, yet many cities struggle with inefficient and outdated complaint resolution systems. Common issues such as potholes, garbage accumulation, drainage blockages, and malfunctioning streetlights often go unresolved due to delayed reporting, poor tracking mechanisms, and ineffective coordination among municipal authorities. Traditional methods of complaint submission involve manual paperwork, phone calls, or in-person visits, which are timeconsuming and lack transparency. To address these challenges, a modern, AI- driven, and cloud-powered complaint management system is necessary.

CivicFix is a cloud-based digital complaint system that allows users to report public issues with ease. The system begins with users uploading a photo of the problem, which is then processed using Google Maps API to fetch the exact loca- tion details automatically. Once the image and location are captured, a machine learning model analyzes the photo and categorizes the issue into one of four types:

- Potholes and Garbage (handled by BBMP)
- Drainage Problems (handled by BWSSB)
- Streetlight Issues (handled by BESCOM)

Each complaint is stored in a separate database table corresponding to the respective department, ensuring that grievances are routed directly to the appropriate authorities without manual intervention.
To facilitate efficient resolution, CivicFix provides separate logins and dashboards for users and department officers. Citizens can submit complaints, track their progress, and receive updates, while officers from BBMP, BWSSB, and BESCOM can view, accept, and address complaints assigned to their department.
By integrating cloud storage, AI-based classification, automated routing, and real-time tracking, CivicFix offers a scalable and transparent solution for urban infrastructure management. It enhances citizen participation, improves municipal efficiency, and promotes faster problem resolution, ultimately contributing to smarter and better-managed cities. With increasing urban populations and civic pressure, traditional complaint systems are proving inadequate. CivicFix offers a technological alternative that not only streamlines processes but also enhances government accountability. The system is extensible to handle other civic areas such as water supply, sanitation, and public safety, making it a robust candidate for broader e-governance initiatives.

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II. LITERATURE SURVEY REFERENCES

[1] Digital Transition Reduces Complaint Resolution Times: J. Kitchin and M. Lauria (2021) explored the evolution of public grievance systems, emphasizing the need to transition from manual, paper-based processes to digital and cloud-enabled platforms to enhance service delivery and accountability in smart cities. Their analysis of urban digital governance systems in Europe and Asia found that the adoption of these platforms led to an increase in public satisfaction and resulted in a 35% reduction in average complaint resolution times.

[2] AI Provides Reliable Context for Complaint Triage: S. Ghosh, R. Gupta, and A. Mishra (2020) argued that incorporating machine learning (ML) models, particularly those leveraging image data, offers reliable visual context for civic complaints. This automated approach is essential for reducing the labor-intensive burden of manual sorting, thereby mitigating the risk of human error and minimizing delays in complaint handling.

[3] High Accuracy of CNNs for Issue Classification: S. Ghosh, R. Gupta, and A. Mishra (2020) demonstrated the efficacy of deep learning in categorization, training a Convolutional Neural Network (CNN) on labeled civic issue images (e.g., potholes, garbage, streetlights). The CNN achieved over 92% classification accuracy in test environments, enabling the automatic, real-time assignment of complaints to appropri- ate municipal departments based solely on the visual content.

[4] Geolocation Integration Critically Reduces Location Errors: L. Anand and R. Kumar (2020) highlighted the necessity of integrating geolocation technologies, specifically the Google Maps API, into civic complaint management systems. Their methodology, which utilizes GPS-based data collection and geofencing, ensured precise spatial tracking of problems, leading to a demonstrable 95% reduction in location-related errors in submitted complaint entries.

[5] Smart Routing Enhances Field Response Logistics: Further analysis by L. Anand and R. Kumar (2020) revealed that employing smart routing mechanisms based on geotagged complaint data significantly streamlined municipal operational logistics. This strategy for dispatching repair crews resulted in a practical gain, reducing the average field response time by 28% and facilitating proactive maintenance planning in identified high-frequency complaint zones.

[6] Dashboards Improve Speed and Quality of Municipal Decisions: H. Rahman and T. Raj (2021) focused on the design and functionality of interactive dashboards in digital civic platforms, distinguishing between citizen tracking and officer management views. They concluded that the use of officer dashboards, which incorporate real-time charts and Key Performance Indicators (KPIs), successfully improved the speed and overall quality of municipal decision-making.

[7] Dashboards Boost Staff Efficiency and Public Trust: In their usability study, H. Rahman and T. Raj (2021) found tangible operational benefits, reporting that 88% of municipal staff experienced improved workload prioritization due to the organized data provided by officer dashboards. Simultaneously, the provision of real-time complaint status updates fostered increased public trust and accountability across departments.

[8] Scalable Urban Systems Require Serverless Cloud Architecture: P. Singh and M. Chaturvedi (2021) outlined a necessary scalable cloud-based framework for urban digital services like complaint redressal systems. They specifically advocated for adopting a serverless architecture, lever- aging components such as Firebase Functions or AWS Lambda, along with cloud object storage, to efficiently manage fluctuating user demand and high volumes of data.

[9] Cloud Infrastructure Guarantees Uptime and Data Integrity: P. Singh and M. Chaturvedi (2021) confirmed the reliability of utilizing dedicated cloud infrastructure (such as Firebase Firestore and AWS S3) for system storage and processing. Their implemented prototype demonstrated reliable performance, achieving near-100% uptime and guaranteeing data integrity and compliance through effective auto-scaling, backup mechanisms, and robust audit trails.

[10] Transparency and Auditable Tracking are Essential for Service Quality: The systematic literature review on "Dimensions of E-Complaint Service Quality" (IEEE, 2019) emphasizes that transparent, unified platforms are fundamental to increasing public satisfaction and addressing neg- ligence in municipal issues. Providing real-time tracking capabilities and centralized monitoring helps ensure that every complaint is visible and auditable, thereby promoting responsible governance and public accountability.

III. METHODOLOGY

The proposed system, CivicFix, is a cloud-based civic grievance redressal platform that aims to simplify and digital-ize the complaint reporting and management process in urban areas. Traditional methods of lodging civic complaints often involve lengthy manual procedures, unclear communication channels, and poor tracking mechanisms. These limitations contribute to delayed responses and lower citizen satisfaction. CivicFix addresses these inefficiencies by providing a web- based solution that automates the entire workflow — from complaint registration to classification,

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routing, and resolution tracking. It enables users to register civic issues such as potholes, waste accumulation, water leakage, and streetlight outages in real time. The system fetches the user's current geographical location automatically through the Google Maps API, eliminating the need for manual entry. This ensures ac- curacy and authenticity of complaint data. A machine learning component enhances the system's intelligence by supporting automated classification of complaints.

The overall goal of CivicFix is to foster a more responsive and transparent interaction between citizens and civic authori- ties, ultimately contributing to efficient urban management and governance.

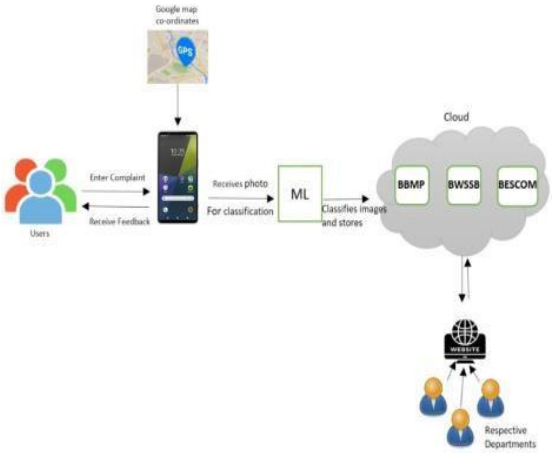

Fig. 1. System Architecture of CivicFix

A. System Architecture

The architecture of CivicFix follows a three-layered design comprising the User Interface Layer, Application Layer, and Data Layer. This structure ensures modularity, scalability, and ease of integration with other services.

- **User Interface Layer:** This layer provides a web-based platform where users can submit complaints. The interface allows users to enter details such as issue description and upload images for better context. The Google Maps API is integrated to automatically fetch the user's latitude and longitude at the time of submission. This geotagging mech- anism ensures that complaints are precisely mapped to their real-world locations.
- **Application Layer (Backend Server):** The backend server acts as the central processing unit of the system. It is responsible for managing requests, validating user input, storing data, and invoking the machine learning model. Once a complaint is submitted, the backend processes it by assigning timestamps, user IDs, and location metadata. The machine learning model determines the appropriate munici- pal department or authority to which the complaint should be routed, based on its category. It also manages status updates, such as "Pending," "In Progress," or "Resolved," ensuring smooth communication between the user and the civic body.
- **Data Layer (Cloud Database):** The data layer is built on a cloud-hosted database that securely stores all user information, complaint details, and corresponding location data. Each complaint record includes attributes like descrip- tion, image reference (if uploaded), coordinates/location, department mapping, and timestamps. The use of a cloud platform ensures data persistence, scalability, and real-time synchronization between multiple users and authorities. This architecture supports future expansion, such as integration with city dashboards or analytics modules.

B. Data Flow

The data flow in CivicFix begins at the user level and prop- agates through various system components until the complaint is routed to the appropriate authority and tracked until closure.

- **Complaint Submission:** When a user submits a complaint via the web interface, the system automatically captures the user's geographical coordinates using the Google Maps API. The coordinates are reverse-geocoded to obtain the area name, ensuring that every complaint is tied to an exact real- world location.
- **Backend Processing:** The backend validates the user's submission, ensures completeness, and records the data in the database. It then invokes the machine learning service to classify the complaint into relevant categories such as sanitation, electrical, or road maintenance.
- **Routing and Storage:** Based on the classification results, the complaint is routed to the concerned department. All complaint details, including timestamps and routing history, are stored in the cloud database. The backend continuously updates the status as actions are performed by the authori- ties.
- **User Tracking and Feedback:** The user can view the status of their complaint in real time through a tracking interface. This transparency ensures accountability and encourages citizen engagement by providing visibility into how

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civic authorities handle grievances.

- This structured flow ensures minimal manual intervention and reliable data-driven automation in complaint handling.

C. Machine Learning Model

The machine learning component plays a key role in au- tomating the categorization of civic complaints. It analyzes input features such as the textual description and location metadata to identify the type of issue. The model enables the system to route complaints efficiently to the appropriate department, thereby reducing delays and human dependency. This intelligent layer adds adaptability to the system, al- lowing it to learn from new data and continuously improve classification accuracy over time.

D. Implementation Details

The implementation of CivicFix followed a modular devel- opment approach to ensure flexibility and maintainability. The frontend was developed using web technologies such as Re- actJs, and JavaScript, providing a user-friendly interface. The integration of Google Maps API enabled automatic fetching of the user's location, ensuring precise geotagging of complaints without requiring manual input.

The backend server was implemented using the Flask frame- work, a lightweight Python web framework well-suited for RESTful API design. Flask handles communication between the frontend and the cloud database, processes complaint data, and interfaces with the machine learning model through dedicated API calls.

The database was deployed on a cloud platform that is Firebase Cloud, ensuring real-time updates and synchroniza- tion. Each module of the system was tested individually and then integrated for end-to-end validation. Unit testing verified the correctness of data transactions, while integration testing ensured reliable connectivity between the frontend, backend, and database layers. Version control was maintained through GitHub, allowing efficient collaboration and version tracking among developers.

E. Tools and Technologies Used

The development and deployment of CivicFix relied on a combination of software tools, libraries, and cloud-based services, summarized as follows:

- **Programming Languages:** Python (for backend and ML components), ReactJS (for frontend interactivity), and HTML/CSS (for layout and styling).
- **Frameworks and Libraries:** Flask for backend API cre- ation; ReactJS for frontend logic; TensorFlow/Keras or Scikit-learn for ML development.
- **APIs and Services:** Google Maps API for automatic loca- tion fetching; REST APIs for data communication between modules.
- **Database:** Firebase Cloud for scalable, real-time data stor- age and synchronization.
- **Deployment Platform:** Cloud hosting for high availability and scalability.
- **Version Control:** Git and GitHub for source code manage- ment and collaborative development.

IV. RESULTS AND DISCUSSION

The proposed Convolutional Neural Network (CNN) model was trained for 10 epochs and fine-tuned for 5 additional epochs to enhance feature extraction and generalization. The model achieved an overall training accuracy of 90.3% and a validation accuracy of around 82%, indicating strong learning capability with slight overfitting.

The loss curve showed steady convergence, confirming that the model effectively minimized classification errors during training.The confusion matrix demonstrated that the model could accurately distinguish between most classes, highlighting the robustness of the CNN in handling complex visual

A. Machine Learning Model

In this project, we employed a Convolutional Neural Network(CNN) for image classification.CNNs are particularly effective for image-based tasks because they automatically learn spatial hierarchies of features through convolutional layers.

Our model used a pre-trained network that was fine-tuned on our dataset to improve feature recognition and accuracy. The convolutional layers extracted essential visual patterns, while pooling and dense layers helped reduce noise and perform classification efficiently.

The training process used data augmentation and learning rate tuning to improve model generalization. As a result, the CNN achieved high accuracy and consistent validation results, proving its suitability for our image classification task.

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CONFUSION MATRIX REPRESENTING ML MODEL PERFORMANCE

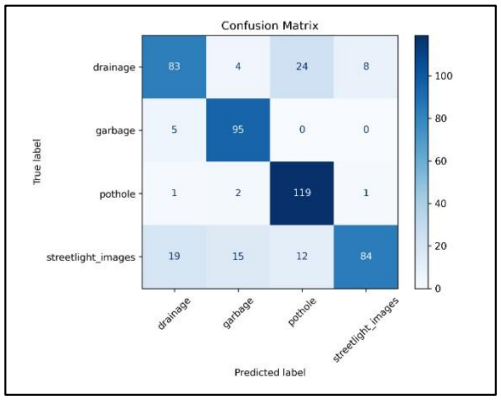

Fig. 2. Confusion Matrix

MODEL TRAINING VS VALIDATION LOSS

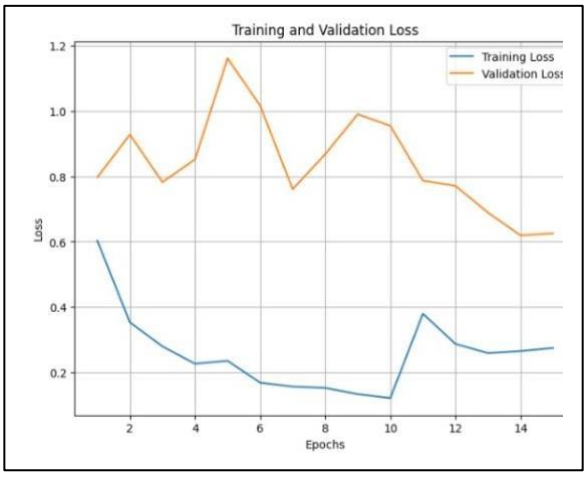

Fig. 3. Line Graph

MODEL TRAINING VS VALIDATION ACCURACY

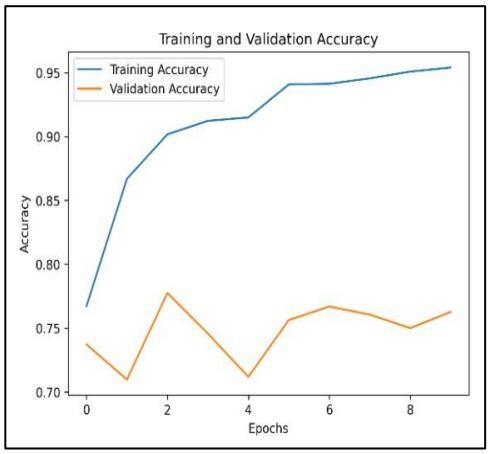

Fig. 4. Confusion Matrix

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V. CONCLUSION AND FUTURE WORK

CivicFix represents a transformative step toward building smarter, more responsive urban environments. By harnessing the power of AI-driven complaint classification and smart routing, our system bridges the gap between citizens and municipal bodies, ensuring that urban issues are not only heard but resolved efficiently. The platform's intelligent architecture enables automatic categorization, prioritization, and redirec- tion of complaints to the appropriate departments—reducing response times, improving service delivery, and enhancing public trust in governance.

As cities continue to grow and urban challenges become more complex, CivicFix provides a scalable and adaptable framework for civic engagement and problem- solving. It em- powers citizens to be active contributors in shaping better communities, while equipping authorities with the tools to act decisively and transparently. In essence, CivicFix is not just a complaint management system—it's a vision for a smarter, more inclusive future where technology and civic responsibility go hand in hand.

In the future, the CivicFix platform can be enhanced with several key implementations to broaden its impact and us- ability. Multi-language support will allow citizens to sub- mit complaints in their local languages, thereby improving inclusivity and ensuring participation from diverse linguis- tic communities. The system can also expand its scope by incorporating additional complaint categories such as water leakage, electricity outages, and fallen trees, making it more comprehensive in addressing urban infrastructure issues. Fur- thermore, city-wide and state-wide scaling of the platform will enable deployment across multiple municipalities, pro- moting standardized civic issue reporting and coordinated resolution mechanisms at larger administrative levels.

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