AI Driven Civic Complaint Management with Priority Modelling

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Civic complaints reflect the efficiency and quality of their public service delivery mechanisms by municipalities. In India, there are many grievance redressal systems that currently use only manual processes which can produce a delayed response time and create poor tracking of complaints that may not receive a response at all. The project proposes an AI powered civic complaint management system that features smart automation and decision making capabilities. The citizens of the communities will be able to enter complaints via a web application or chatbot utilizing text, images, and video as evidence. BERT will be used to classify complaints, ResNet will provide image severity analysis, XGBoost will provide priority prediction, and Rasa will provide conversational support for citizens submitting their complaint. Each complaint will be automatically classified, prioritized, and routed to the correct departments for rapid resolution. The proposed system enhances transparency, efficiency, accountability, and rapid response times associated with smart municipal governance.

Keywords: Civic Complaint Management, BERT, ResNet, XGBoost, Rasa, Priority Prediction, Smart Governance, Municipal Administration, Natural Language Processing, Computer Vision, Machine Intelligence.

1. Introduction

As urbanization continues to grow exponentially along with an increase in population, municipalities are struggling to provide efficient public service and municipal infrastructure in response to increased demand. Municipalities are responsible for maintaining the roads, sanitation and drainage system, water supply, street lighting, and waste management; however, individuals experience a host of civic issues such as potholes, overflowing trash bins, blocked drainage pipes, leaking water pipes, and broken streetlights. An effective grievance redressal system is therefore necessary to help improve urban living conditions and increase the level of satisfaction for citizens living in urban areas.

Most current civic complaint handling systems rely on manual logs, telephones, or basic online portals. Their inefficiencies result in slow complaint processing times, misrouting to departments, lack of visibility within the system as well as ineffective monitoring, and the inability to intelligently determine priority. Inefficient workflows can mean some critical complaints will remain unresolved for significant lengths of time; this also negatively impacts citizens` ability to track the status of their complaints or to receive timely notifications.

The recent advancements in Artificial Intelligence (AI), Machine Learning (ML), and Natural Language Processing (NLP) and Computer Vision technologies can help create smarter municipal governments through improved municipal complaint systems. The AI Driven Civic Complaint Management System with Priority Modelling is an integrated AI-based system where citizens can submit complaints using a web portal or chatbot using text, images, and location data; the system will be able to assess complaint priorities, auto classify their type of complaint, route them to the appropriate department, and provide real-time notifications to the citizen (transparency), all of which enhances the ability for citizens to engage and be involved in the governance of their smart city.

2. Literature Review

Ramesh (2024) developed an intelligent urban grievance system using natural language processing (NLP) techniques to automatically categorize citizen complaints. The developed system increased the accuracy of complaint classification and provided a reduction in the manual routing process of complaints. One of the limitations of this NLP framework, however, was that it did not include features to image analyze severity and intelligent escalation.

Kumar and Pria (2023) built an online municipal complaint portal that allowed citizens to file complaints via an online system and track those complaints digitally. Although the municipal complaint portal improved digital accessibility to files complaints, it did not contain features to provide citizens with artificial intelligence (AI)-based complaint predictions or automated complaint prioritization.

Arun (2024) developed an infrastructure monitoring system using convolutional neural networks (CNN) deep learning based solutions for detecting road damage (i.e., potholes) from images submitted online. The accuracy of their developed system to recognize images of potholes or road damage was high; however, the developed system did not include features to manage complaints or to provide an intelligent routing mechanism.

Rahman et al. (2025) proposes a framework for 'smart governance' with the use of Machine Learning Algorithms that realize the optimization of public services. The research study focuses on predictive analysis (PA) in municipal resources allocation and on complaint trend analysis; however, there was no provision for any real-time citizen interaction through the use of chatbots in the proposed smart municipal governance framework by the authors.

Patel and Sharma (2024) created a Public Grievance Support System using chatbots based upon Natural Language Processing (NLP) and their model led to better interaction between citizens and administrative departments thereby reducing goodwill as well as the workload on administrative personnel. However, the system created did not include intelligence around prediction of priorities or have the capabilities to analyse images.

Recent studies using the BERT transformer architecture along with XGBoost algorithms have produced very high accuracy rates in classifying complaints and predicting the importance of those complaints. Unfortunately, the systems available today typically only address the individual components associated with municipalities. In other words, you would use either the public service or an administrative department to file or report a complaint, or you would use "AI" through a chatbot. By comparison, the new types of systems are able to incorporate multiple components of AI based technologies into one solution to develop a fully integrated smart governance application for municipalities.

3. Existing System and Drawbacks

Today's City grievance systems are mostly comprised of semi-automated, or manual methods, such as telephone complaint centers at the municipal office,in-person registration, email-based complaints, and basic online portals for submitting complaints.

A. Manually Registered Complaints

The majority of citizens have to travel to the municipal office in person, or call a service by phone, to get their complaint in the system. Both methods create excessive amounts of paper, and result in an undue amount of excess administrative work for City staff.

B. Delayed Processing of Complaints

Prior to being routed to the appropriate department, each complaint must go through a manual processing step, which can contribute to an extended timeframe for proper routing, and thereby contribute to important municipal concerns being open for extended periods, awaiting resolution.

C. Lack of an Intelligent Complaints Prioritization Method

Municipalities do not have an automated process to assign priorities to either the urgency of complaints or to the significance of complaints. As a result, many serious complaints, such as water leaks, potholes or blocked drains, will not receive a timely response from the municipality.

D. Lack of Effective Monitoring and Transparency Citizens often experience difficulty in tracking their complaint or receiving a status update from the municipality after they have registered their complaint. Additionally, municipalities do not have effective tools for monitoring and analyzing the complaint management process.

E. Resistance to Image Analysis

There are few systems in use today that are capable of analysing images that have been submitted for civic issues and determining how severe the issues are. The only way to evaluate complaints is through manual assessment of their acceptance/rejection.

F. Absence of Automation through Artificial Intelligence

Existing systems primarily depend on processing complaints manually before classification, routing and monitoring, thus adding to the operational burden and lowering the overall operational efficiency of municipalities.

4. Proposed System

The proposed Civic Complaint Management System is an AI-driven management system that uses Machine Learning (ML) and Artificial Intelligence (AI) to provide intelligent automation to Municipal Grievance Management.

A. Classification of Complaints:

The Classification of Complaints Model is based on the BERT Machine Learning Model, which will classify all complaints submitted by using natural language processing (NLP) to classify the complaint text description into the following categories: Sanitation, Drainage, Road Damage, Water Supply, and Streetlight Issues.

B. Image Severity Ratings:
All photographs submitted with the complaint will be classified and rated (severity) using the ResNet ML Model.

C. Predicting Complaint Priorities:
The XGBoost Algorithm will predict the priority rating level for each complaint based on the following items are severity of the issue being complained about, type of complaint submitted, urgency of the complaint, and local sensitivity of the complaint; thus providing efficient handling of complaints.

D. Chatbot on Rasa:
A Rasa powered Chatbot will allow citizens to register their complaints, track their complaints through to resolution, and receive automated response to their inquiries through NLP to improve user experience.

E. Automated Complaint Routing/Collaboration Processes
Complaints will be sent to various municipality departments based on their nature automatically based on the complaint information provided to the system. Complaints that have not been resolved will be automatically sent to higher authorities.

F. Notification System
The notification module will send emails and/or SMS messages when a complaint is entered, changed in status, escalated, and/or resolved. This will increase transparency and improve communication between citizens and municipalities.

5. System Architecture

This system is designed to handle complaints from multiple layers, through AI-based analysis, database management, and reporting. It includes the implementation of BERT, ResNet, and XGBoost models with the goal of creating intelligent complaint handling and smart municipal governance.

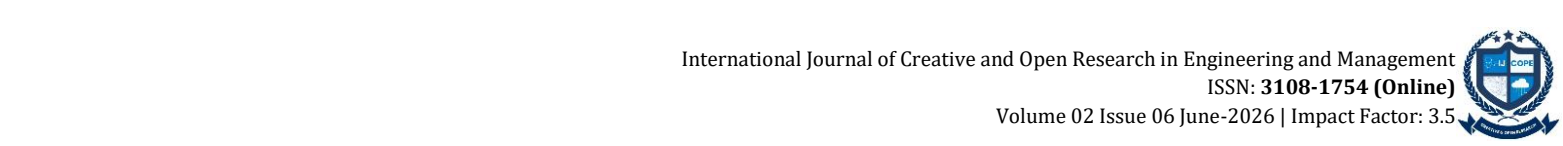
A. Presentation Layer

The Presentation Layer is how citizens will interact with the Complaint Management System. Citizens will use either an online (web-based) or mobile (mobile app) method of registering complaints, uploading images or video, and tracking their complaints through an easy-to-use solution.

B. Application Layer
The Application Layer has been created using the Flask Framework. It provides all the Core Functionality of the system, such as managing User Authentication, Submission of Complaints, Data Validation, Tracking Complaints, and communication between the Frontend and the Database.

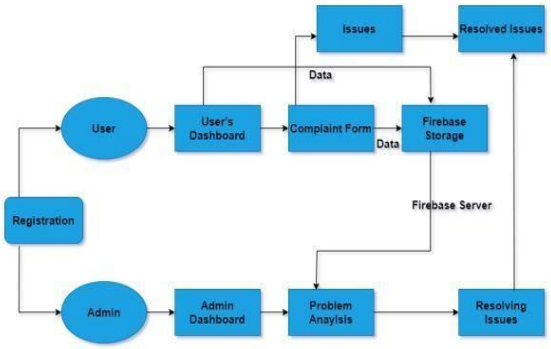
C. Processing Layer
The AI Processing Layer leverages BERT for classifying complaint texts; ResNet for determining the severity of the image in a complaint; and XGBoost for predicting the priority of a complaint in order to process complaints intelligently.

D. Database Layer
In this Layer, MySQL is used to provide secure storage and management of all data associated with the System. This data encompasses all User Details, Complaint History, AI Prediction results, Notification History and all data associated with the various Departments.



E. Analytics and Reporting Layer

The Analytics and Reporting Layer allows users to view reports on average number of complaints, resolution time, department performance, escalation status and distribution of priorities so that they can improve their decision making as well as increase their overall operational effectiveness.



6. Methodology

The system has been created by following Agile processes with iterative builds and tests.

A. Data Collection

Using images of infrastructure and descriptions of complaints about city services, the developers built a data set that could be used to train and test the new functionality. Examples of the problems contained in this data included debris in gutters (trash), potholes in streets, water leaks and blockages in storm drains, as well as broken streetlights.

B. Data Preprocessing

The developers preprocessed the text data by performing various tasks such as tokenization, removing stop words from documents, lemmatizing, and creating vectors to improve the ability of the text to be analyzed. Image data was pre-processed by using various methods such as resizing and normalizing the images and removing any noise from the original image to produce a quality image for training the model.

C. Model Training

Three models were trained to classify complaints using BERT for classifying text, ResNet for analyzing photos, and XGBoost for predicting priority. The models underwent cross-validation to improve the accuracy of the models and ultimately improve the overall performance of the system.

D. Flask API Integration

All three models created during the training phase of the project have been integrated into Flask APIs to provide real-time processing, prediction and communication between the front-end of the application and back-end of the application.

7. Algorithms Used

The proposed system utilizes BERT for complaint text classification, ResNet for image severity analysis, XGBoost for complaint priority prediction, and Rasa for citizen interaction and complaint assistance through a chatbot.

A. BERT for classifying complaints

BERT is a tool that allows the analysis of descriptions of complaints submitted via text. BERT provides the ability to accurately classify complaints into a specific municipal category based on their description by evaluating the meaning within the context of the entire text description.

B. ResNet for identifying severity levels in complaint images ResNet is used to apply deep learning-based methods to conduct analysis of images submitted with complaints and identify damage to the local infrastructure. Additionally, ResNet will also provide the capability to automatically indicate the severity level of the civic issue.

C. XGBoost for predicting complaint priority level XGBoost will provide the ability to predict the priority level of a complaint based on a set of variables (e.g. severity, urgency, category) and subsequently assist the local authorities with determining how to handle the most urgent complaints.

D. Rasa for developing a conversational chatbot
Rasa will provide the capability to create a virtual, conversational chatbot designed to assist citizens with submitting complaints to their local municipality, tracking and following-up on the status of their complaint, and communicating with the local municipality regarding the status of their complaint.

8. Result and Discussion

The proposal was evaluated using data from civic complaints and infrastructure images. The classification of complaints by the BERT model had a
92 percent accuracy, and the image severity was analyzed using ResNet at 90 percent accuracy; the prediction of priority by XGBoost was 88 percent; and the intent recognition was achieved with Rasa at 91 percent accuracy.

The experimental results show that the overall system was able to classify complaints accurately, determine severity of the issue, and efficiently predict the urgency of complaints. The AI chatbot also assisted with both registering complaints and tracking their status, therefore minimising employee workload and enhancing communication between citizens and employees.

Ultimately, the system illustrated faster processing of complaints, greater accuracy when routing complaints, greater transparency of the CI system, lower administrative workload, and greater satisfaction from citizens in smart municipalities governing themselves.

9. Conclusion

With the AI-Powered Civic Complaint Management System with Priority Models: The Smart City's Effective Management of Complaints this provides a quick, efficient process to manage all municipal complaints. By using BERT, ResNet, XGBoost and Rasa technologies we can now accurately categorize all complaints, analyze the degree of severity through an image, predict what level of priority to give each complaint, route them accordingly, and interact with the citizen submitting each complaint.

The system will provide increased levels of transparency,accountability, operational effectiveness, and an overall increase in citizen satisfaction from the municipal government. By automating the complaint handling process the manual work created through handling of complaints has been drastically reduced and response to critical municipal issues will now be quicker.

The proposed framework assists in the development of a Smart City by transforming the traditional complaint management system using Artificial Intelligence and a data driven approach to decision making.

10. Future Scope

Enhancement of the proposed AI-based Civic Complaint Management System could further increase the smart municipal governance efficiency, accessibility and intelligence through several avenues. The system could be improved by including multilingual options for the complaint processing so that citizens can file complaints in their mother tongue and make the platform more user friendly and inclusive.

Utilisation of GPS-based clustering of civic complaints can enable authorities to identify areas experiencing significant civic issues such as potholes, overflowing garbage bins and blockages in drainage systems, and facilitate timely resource allocation and enhanced urban planning.

Integration of a mobile application for real-time complaint registration, tracking, notice notifications, and updates directly to citizens' smartphones.

Future iterations of the system could integrate blockchain technology to create secure, dependable, and tamper-proof records of complaints. Utilisation of predictive AI analytics to analyse historical complaint data could enable authorities to predict when infrastructure will fail before it is critical.

Integration of IoT sensors will enable the real time monitoring of civic infrastructure including water pipelines, streetlights, drainage and waste management.
Integration of voice-enabled functionality through which citizens could submit complaints using their voice will enhance accessibility of the system for elderly and differently-abled citizens.

Advanced analytics dashboards may assist municipalities in making data driven decisions that will improve the effective and efficient management of resources and strengthen smart city governance and the efficiency of public services.

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