



(RESEARCH ARTICLE)



Multimodal artificial intelligence priorities and analysis portal in citizen services

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International Journal of Science and Research Archive, 2026, 18(03), 645-651

Publication history: Received on 29 January 2026; revised on 07 March 2026; accepted on 09 March 2026

Article DOI: <https://doi.org/10.30574/ijrsra.2026.18.3.0473>

Abstract

Transparent governance means a lot to public grievance management, yet currently much of the existing digital portals in the world remain doing manual classification, a process that slows down the operations and directs a complaint to the inappropriate locations. This project is an introduction to Civic Connect, an AI-based multimodal grievance analysis and prioritization system based on BERT- (Bidirectional Encoder Representations from Transformers) and NLP with the goal to automate the handling of the complaints. The system allows citizens to report their complaints using a free text interface and voice notes or a custom built geo-tagged camera used to add the location and time data to the photos. On the back-end, the system intelligently classifies the complaints to either the proper departments and priorities based on an Explainable Prioritization Engine (X-PE) to make it obvious why an instance is urgent. To maintain fairness, it also has a Grievance Fairness Audit System (GFAS) to check for bias in the region as well as a Proactive Grievance Hotspot Prediction (PGHP) module that predicts spikes in complaints using historic data. It can be used as a web app with a Node.js/express backend and a Next.js dashboard to provide admins with real-time insights and visualizations, and this has made public administration more answerable and responsive than never before.

Keywords: Artificial Intelligence; BERT; Natural Language Processing; Multimodal Analysis; E-Governance; Geo-Tagging; Explainable Artificial Intelligence

1. Introduction

Citizen-based administration and good governance entails the existence of public grievance system. Conventional methods of complaint management are mostly manual, which leads to slowness of the process, subjectivity, and non-transparency. As the e-Governance efforts expand, it is becoming a requirement to have intelligent tools that would enable processing of high volumes of complaints effectively.

This endeavour is proposing an analytical platform that is powered by AI and automatic in categorizing, prioritizing, and evaluating grievances based on machine learning and NLP. The proposed solution based on multimodal evidence analysis and explainable AI will enhance the accuracy and inclusivity of decisions made by users as opposed to the current systems that use only text data. Although the system now only involves analysis and prioritization, extensions in the future might involve automated routing and escalating the entire end to end grievance system.

2. Literature survey

Through this project, the author of this paper created a rule-based system to transform public dissatisfaction redressal into using deep semantic analysis with BERT to achieve its objective: transformed public dissatisfaction into a system aligned with Rule 21 ideals. In this project, the author of this paper developed a system that converts public

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dissatisfaction redressal to deep semantic analysis using BERT to meet its purpose: redressed public dissatisfaction into a system consistent with the Rules 21 norms.

In this paper, the focus will be upon creating grievance systems based on the traditional portal (e.g., CPGRAMS) to advanced deep learning architecture. The authors note how automated systems of previous times were founded on predefined rules and matching of keywords which in many cases failed to know local slang or the actual context and hence were causing manual bottlenecks and misrouting. The study is suggesting to employ the method of Bidirectional Encoder Representations of Transformers (BERT) to accumulate profound semantic meaning and context in the unstructured text complaints and no longer necessitate manual sorting.

2.1. Multimodal AI Architectures to Severity-Aware no-goal Prioritization: E-Government Journal of Intelligent Public Systems, 2024.

In the current study, the authors are concerned with the integration of multimodal learning (text, image and audio-data combination) that will help to understand citizen complaints better. The study finds a critical prioritization gap in traditional systems, which typically handle the matters based on the first-come, first-served. Updating automated sentiment analysis and image-based reasoning can make this multimodal method identify correctly the High Priority cases (e.g., fire, medical emergencies) and automatically acquire the level of severity.

2.2. Geo-tagging and reverse geocoding in fighting fraudulent reporting in digital governance - International Journal of Smart Cities and e-Governance (2023)

The issue of evidence authenticity in the normal public portals is very critical and is discussed in this paper. The authors draw focus to the fact that the existing systems allow users to post photos of anything without conducting any verification regarding the date and location of the photo was captured leading to false reporting. To bridge this gap, this study suggests the application of geo-tagging and reverse geocoding technologies, which automatically obtain the GPS coordinates and transform them into readable street addresses so that the information about locations is burnt into images to prove the evidence.

2.3. Abstract There are 76 references in total to article Evaluating AI-Enabled Helplines: NLP Applications in National Consumer Grievance Systems of the Computational Linguistics in Governance Journal, 2025.

The study will be founded on an overview of the recent real-life applications of Natural Language Processing (NLP) in government agencies, which is specifically examining an effort by the National Consumer Helpline, 2025. The document reveals that the performance of the NLP to perform the process of automatically reading, tagging and sorting cases was successful and led to an average of approximately 27 percent decrease in the average time of resolution. These results are compelling to the adoption of AI to assist in reducing the current load on human agents where thousands of complaints are processed on a daily basis.

2.4. Bridging the gap: elucidating AI and building accessible interfaces to citizen-centred platforms - Journal of AI and Public Administration (2025)

This paper singles out the dissonance between extremely intricate AI models and non-technical people to implement them. The authors indicate that advanced AI is not commonly integrated into easy-to-use simple user interfaces. The article proposes a single system with the help of Explainable Prioritization Engine (X-PE) and a token-free portal. Through supporting text, audio and images, this method keeps it transparent and inclusive in as far as digital delivery of public services is concerned without intricate log-in platforms.

3. Existed and proposed system

3.1. Existed System

The mass legacy platforms which are the corner stone of the current topography of redressal of the grievances of the citizens are predominantly characterised by Centralized Public grievance Redress and monitoring System (CPGRAMS) which grievances addresses more than 91 departments and covers over 15,000 categories. Such systems despite their size are highly reliant on manual processing and broad taxonomies that frequently direct incorrectly ticketed passengers and obscene delays in fixing. Though later incremental improvements have been noted (such as the AI-powered application developed by the Ministry of Defense and IIT-Kanpur to reduce the number of human intermediations by searching with keywords and delivering the relevant responses) and simple keyword-matching or rule-based classifier solutions have been developed that are much more effective at reducing the time of resolution by 66 to 48 days (notably) the massive majority of portals still follow the same primitive architecture of matching a query

with a response. Therefore, these systems are not usually real-time prioritized, and treat issues marked the critical ones in a queue-like fashion instead of prioritization fashion and can also experience data quality problems due to informal or dial-lady inputs. Further, multilingual assistance is yet to be seen given the extreme disparity as most of the websites only accept English and Hindi and thus, the complaint made in any other native language, i.e., Telugu or Tamil, is not allowed or gets translated manually.

3.2. Proposed System

Civic Connect platform suggests a revolutionary solution to a complaint portal of the public, incorporating Artificial Intelligence (AI), Multimodal Evidence Gathering and Geo-Spatial Technology to develop an automated, candid, and responsive system of governance. Unlike traditional systems that use manual sorting and unverified inputs, in this framework, BERT-based AI engine is used to categorize complaints in real-time, prioritizing its urgency and verifying the evidence with real-time geo-tagging.

The system architecture is built in such a way that it merges some of the key modules, such as Citizen Lodging (Smart Lodge), AI Analysis Engine, Admin Dashboard, and Secure Cloud Storage. The deep learning algorithms analyze user submissions, which include text description, voice notes, and pictures, to find out the exact department and level of priority. At the same time, a Geo Tagging module is a module that guarantees that all the evidence is marked with accurate location and time metadata that discourages the possibility of fraudulent reporting.

The key features of the proposed system are:

- **Multimodal Submission:** Access to the interface is freely available to all literacy levels with a text, audio, or image way of submitting a grievance.
- **Automated Intelligence:** Make the complaint Processing with a fine-tuned version of BERT will automatically categorize complaints (e.g., Sanitation, Roads) and assign priority (High, Medium, Low) using semantic arguments to remove manuals as bottlenecks.
- **Evidence Authenticity:** A tailor-made Geo-Camera application incinerates real time GPS coordinates and timestamps directly onto the evidence image making it authentic and allowing police to trace the location to the exact point.
- **Explainable Prioritization (X-PE):** The system offers logic-based priority allocation meaning that matters with high severity such as fire or medical emergency are immediately identified to be handled through urgent response.
- **Scalable Architecture:** The architecture is based on a distributed MERN stack (MongoDB, Express, Next.js, Node.js) where Cloudinary is used to store images and other media, and which is expected to be expanded to larger urban centres and maintain performance stability.

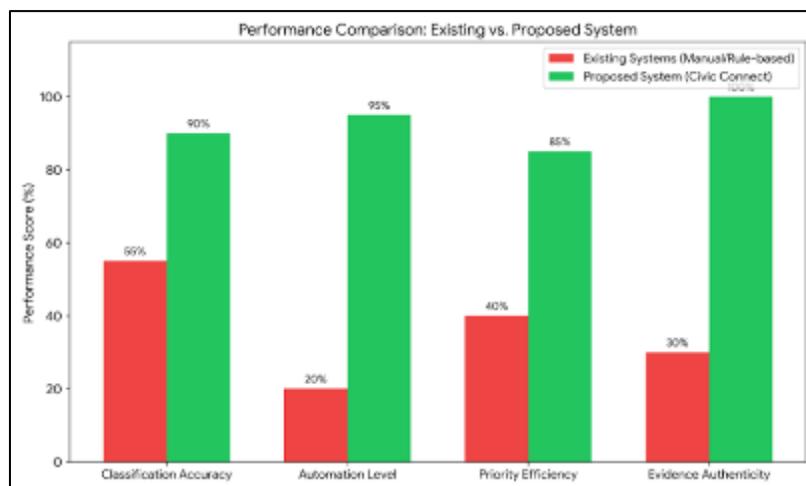


Figure 1 Civic Connect System Architecture

4. Methodology

The strategy regarding the Civic Connect system is set to revolutionize the manual and time-consuming process of redressing grievance to automated and AI-based system. This is predetermined by the ground of Natural Language Processing (NLP), Geo-Spatial Technology, and Cloud Computing so that every complaint must be adequately rated, categorized, and proved in real-time. The manner of its creation can be divided into the following key points:

Multimodal Data Collection: The system will be programmed in such a way that it accepts various inputs in order to make it inclusive. The data is collected with the help of a token-free interface because the citizens would be able to submit the grievances in the form of a text description, voice recording (the citizens not using the text interface) and visual evidence (images). The meta-data which has real time GPS position and time is also automatically assembled together with the system and forms a complete data point of each complaint.

Pre-processing Data: This step involves pre-processing the raw data to provide the final input data. The text descriptions are also cleaned (removing noise) - e.g., with special characters, stop words etc. as well as standardized with the assistance of Tokenization technologies in order to prepare the text descriptions to the AI model. Meanwhile, the media files (audio/images) are placed and processed in the cloud storage (Cloudinary) and generate accessible URLs that are linked with the grievance record.

AI-Based Classification and Prioritization Engine: This is the simple decision-making layer. The text is then properly sent to a fine-tuned version of BERT (Bidirectional Encoder Representations from Transformers) model. This engine:

Assigns semantics to categorize the complaint by particular departments (e.g., Sanitation, Electrical, Roads).

Uses Priority (High, Medium, Low) depending on the strictness of the language used (e.g., differentiating no light and electric shock).

Geo- Spatial Verification Module: The strategy will involve having a strict validation layer to authenticate the legitimacy of complaints. The image of the evidence is read using the Geo-Tagging type of reasoning and the Latitude, Longitude and formatted address of the other side of the street written on it. This burned-in metadata does not permit presenting the fraudulent and aged pictures and aids the authorities to determine the actual point of the issue avoiding the manual search of it.

Interactive Interaction & Accessibility: It is based on interaction with the user due to the system responding to his/her interaction. Visual analytics (live heatmap of clusters of complaints and filtering tools) are also available to the administrators in an interactive dashboard. The interface has been simplified to make the barriers of logs unattainable to the citizens and any demographic group can use the technology despite their level of technicality.

Resolution & Feedback Loop: This is the final stage which tries to conclude the process of grievance. The system enables a fluidity of feedback system wherein the actions of the admin (Resolving or Marking as Spam) are reflected immediately on the status of the citizens My History page. This free communication renders them responsible and puts on the notice of the complainant to the point where the issue is resolved afterwards.

4.1. System architecture

The suggested Civic Connect is developed using the support of a scalable MERN (MongoDB, Express, React, Node.js) architecture with the use of the latest AI microservices and cloud media management. It will also be scalable with an architecture that is secure and has the capability to handle multimodal data (text, images, audio) in real time to provide an automated grievance processing and transparent governance.

- **Architecture:** The house is divided into several components:
- **User Interface:** Provides user interface that is responsive and user friendly by the citizens and the administrators.
- **Smart Lodge:** It has a dedicated token free submission portal which logs complaints without one needing to log in.
- **Geo-Camera:** This is a special camera app, which inserts the real time GPS positioning, and time onto the photographs of evidence before submission.
- **Central Processing Unit:** It is the primary API endpoint where all the requests are received between the frontend and database and ML model.

- **Security:** Here, the system makes use of the Dual-Access logic idea by segregating public access to the system and secure administration privileges. Authentication (JWT), uploading of files and forwarding of data to the Python AI module.
- **Data Storage:** Data that is disorganized. Complaint's history, customer records, departmental records, resolution history.
- **Intelligence Layer:** A particular microservice, which is fine-tuned on a BERT (Bidirectional Encoder Representations from Transformers) model.
- **Classification:** According to the declaration, the department to apply in a text of grievance is automatically predicted (e.g., Sanitation, Roads).
- **Prioritization:** Conducts sentiment analysis to provide a sense of urgency (High, Medium, Low) based on the strength of the complaint.
- **Asset Storage:** The asset storage manages the storage and optimization of heavy (evidence images and voice notes) media files.
- **Performance:** Shunts the media in use to a Content Delivery Network (CDN), which leaving the core application server fast and light.
- **Transformation:** Carefully examines the uploaded files making them web friendly.
- **Real-Time Updates:** The itself suggests constantly updating the status of grievances in the database (e.g. "Pending" to "Resolved").
- **Transparency:** The transparency is manifested when the citizen clicks on her My History page and rounds the circle between the government and the citizen action.

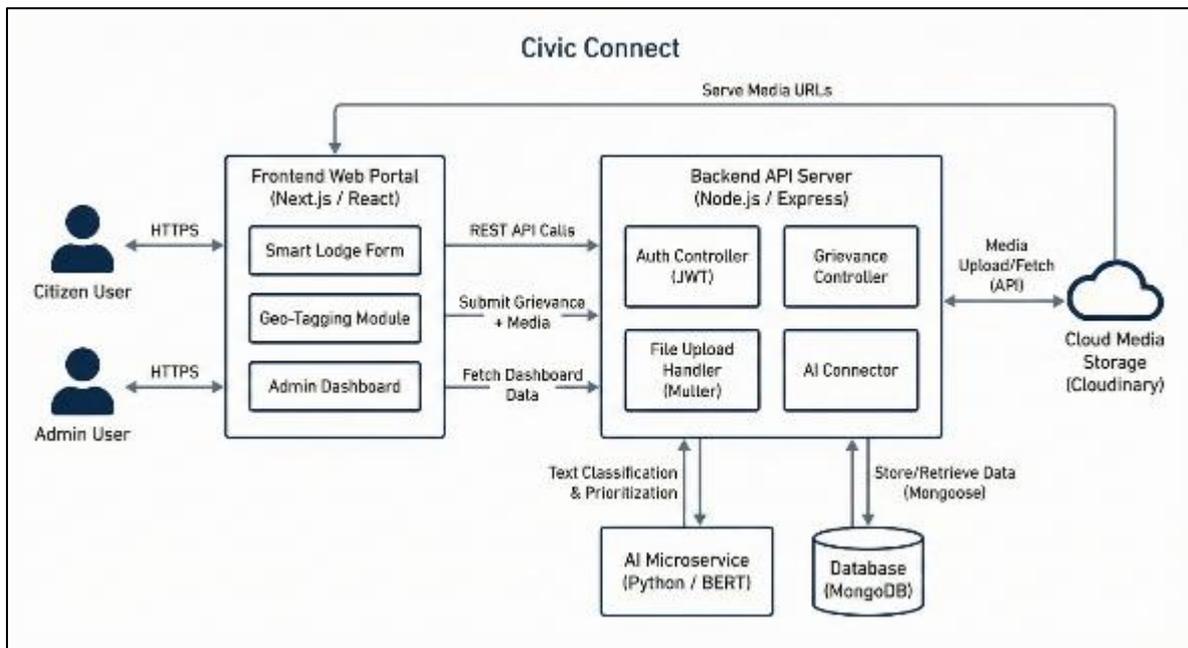


Figure 2 Performance Comparison: Existing vs. Proposed System

5. Implementation

The application of the suggested career path recommendation model implied the combination of the Artificial Intelligence algorithms that have the adaptive learning modules, which are based on the mobile-first architecture. The system is designed in a modular way to ensure scalability as well as flexibility during the deployment in various learning institutions.

5.1. Technology Stack

- **Frontend:** Next.js (+ Tailwind CSS): Frontend mobile application development that is cross-platform and provides accessible and responsive interface;
- **Backend:** Node.js for providing server-side functionality, support API calls, process learner data, inter-module synchronization;

- **Database:** MongoDB to achieve security and structure of learner's profiles, academic history and recommendation history.

Career prediction and completion probability analysis Python (scikit-learn) based machine learning models (Linear Regression and Random Forest Regressor). Adaptive Learning Engine Reinforcement learning strategies Rule based learning strategies were built into the backend to dynamically change the study paths.

Grok API (Open Source LLMs): It is a feedback platform based on AI, multilingual, and natural language interaction platform that improves lecturer engagement.

- **System Workflow:** The Next.js application is used to let learners to register and build profile.

The MongoDB database contains academic records, skills and preferences in a secured manner. The backend is based on Node.js and analyses the data about learners and interacts using the ML Prediction Service. ML Prediction Service (Python + scikit-learn) Service analysis data, predicting proper career paths using the help of regression and ensemble models. The adaptive learning modules build individual study paths and present the information in real-time. Grok API has Multilingual and AI-driven feedback for better accessibility. Recommendations are updated all the time and the refinement occurs through feedback mechanisms to update the profiles of the learners.

- **Deployment:** The system is implemented on cloud-based platform so as to get scalability and accessibility. Students are able to interact with the mobile application no matter where they are and the administrators and teachers are able to monitor progress and provide additional help with the use of the backend dashboards.
- **Testing and Validation:** Student groups were pilot tested to ensure system functioning. Such metrics as accuracy of recommendation, levels of learner satisfaction and engagement was measured. It was constantly improved as per the user feedback and the results monitored.

6. Conclusion

The AI-Based Public Grievance Analysis and Prioritization System (Civic Connect) is one of the examples of how advanced Artificial Intelligence and Geo-Spatial technologies can transform public service delivery. This project solves effectively the critical limitations of traditional grievance redressal mechanisms such as bottlenecks of manual sorting, lack of evidence verification, and accessibility issues of non-technical citizens.

By combining a custom fine-tuned BERT model for intelligent classification and the Geo-Tagging module for evidence integrity, the system ensures the proper and accurate routing and validation of every complaint in real time. The implementation of a "Token-Free" Smart Lodge interface has made a huge difference in terms of inclusivity as the citizens can report the issues without having to go through complicated registration processes. The successful implementation of the Dual-Access architecture (combination of a secure JWT-based Admin Dashboard and an open citizen portal) provides a transparent, accountable, and scalable ecosystem for municipal governance. The result is a robust and data-driven platform that not only guarantees a faster time to resolution but also helps to build a greater sense of public trust within the administration as well.

Compliance with ethical standards

Acknowledgments

We express our greatest thanks and sincere thanks to our project guide Mr. S. Chittibabulu, M.Tech, (Ph.D), Associate Professor, Department of Computer Science and Engineering for his invaluable guidance, constant encouragement and constructive feedback throughout the duration of this project. His technical insights were instrumental in the development of the basic architecture of our system.

We wish to express our sincere thanks to Dr. G. S. N. Murthy, Head of the Department of Computer Science and Engineering for his support and for providing necessary academic resources to complete this work.

We are also grateful to Dr. A. Ramesh, the Principal of Aditya College of Engineering & Technology for his leadership and the conducive environment he gave for research and development.

Finally, we wish to thank the entire faculty and the Management of Aditya College of Engineering & Technology for their help and providing the infrastructure to make this concept into a working result.

Disclosure of conflict of interest

"The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper."

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