



# CivicSense: AI-Based Citizen Complaint Analyzer

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**Abstract.** The issues of infrastructure and other public services like roads, electricity, water supply, and waste management are some of the common causes of complaints by citizens that are experienced by municipalities all over the world. Paperbased systems of complaint handling can cause delays, record duplicate, poor categorization and prioritization. This paper will solve these problems by proposing CivicSense, an AIbased platform that applies Generative AI and sophisticated Natural Language Processing (NLP) to identify, rank, and summarize massive amounts of citizen complaints automatically. The system transforms unstructured textual information into structured actionable insights that can help authorities make a decision. An example of this is that of CivicSense, which can automatically produce weekly analytical reports like; Ward 5 has 42 road-related complaints this week - High Priority. This automated intelligence allows redressing of grievances promptly, provides better transparency and facilitates datadriven urban governance. Finally, CivicSense is expected to enhance the effectiveness of the municipalities through providing prompt responses and enhanced allocation of resources, depending on the trend of complaints in real-time.

**Keywords:** Smart Cities, Generative AI, NLP, Complaint Management, E-Governance, Citizen Services.

## 1 Introduction

It is important to ensure that grievances in the urban governance are redressed timely. However, citizens lodge hundreds of thousands of complaints with municipalities daily such as road damages, power cuts and delayed collection of garbage. These complaints tend to come sporadically via various portals, emails, and even social media which makes the authorities unable to respond effectively to them. The scale of the citizen engagement can be demonstrated by the current national and municipal programs like CPGRAMS in India [1], OneService App in Singapore [2], and the NYC 311 service [3] that still have the problems with automation.

The old systems lack in categorization, trend analysis, and prioritization on the basis of urgency, which causes dissatisfaction among the citizens and ineffectiveness of the systems. The lack of real time insights also means that the authorities are interested more in being reactive as opposed to being proactive where they only address issues when they have become significant civic issues. This does not only lead to slow response time, but also, it leads to the disproportional distribution of resources, including the allocation of the same number of workers to wards that have radically different complaint loads [11].

The potential of Artificial Intelligence (AI) in changing the delivery of the services and its governance has been proven [10] especially with Natural Language Processing (NLP) techniques that can process and categorize high numbers of unstructured citizen complaints [8], [9], [13]. Other transformer-based models including the Attention model [4], BERT [5], GPT-4 [6] and T5 [7] have expanded the features of NLP systems, allowing them to interpret, classify and summarize text in noisy complaints accurately. With the help of generative AI, they can be perfected by making them readable by people, creating trend reports, and actionable insights [16].

In contrast to the rule-based systems, AI-oriented solutions can learn a new pattern of complaints as time goes on, thus being closer to the fast-evolving city fact environments [14], [15]. A number of global programs emphasize the scale of the grievance management problem and the opportunities of the sophisticated AI models. An example is that even though websites such as OneService [2] and Swachh Bharat Mission portals can offer valuable avenues to submit a complaint, a surge in complaints still cannot be scaled because these websites work heavily on manual classification and status updates [1], [11]. The gap is important to note the necessity of smart solutions like Civic Sense, which goes beyond mere tracking to smart complaint analytics [12].

Language ambiguity and diversity are also other challenges. Citizens can place their complaints using regional languages, slangs or give partial descriptions of the problems. These problems can be solved with the help of multilingual NLP models which will interpret and classify complaints regardless of their language or linguistic style [13]. Generative AI also provides the assurance of coherent actionable insights on unstructured, noisy inputs that can be used by decision-makers [16].

The intendment of this work is two-fold. Efficiency and

Transparency: To minimize delays in grievance processing and increase trust with the citizens with a structured, clear information, Data-Driven Governance: To enable the

municipalities to take informed decisions based on complaint analytics to allocate resources, to conduct preventive maintenance and policy making [12], [15].

Civic Sense resonates with the larger vision of smart city governance because it enables governments to change their reactive complaint management approach to the proactive service delivery approach [10], [15]. It is used as a decision support tool as well as a complaint analysis framework in urban planning. As an example, regular complaints on the road in one of the wards may indicate that long-term changes in the infrastructure should be introduced instead of short-term ones [12].

## 2 Related Works

The world has witnessed governments and municipalities that have been experimenting with technology-based systems to simplify the process of managing grievances. The conventional approaches of redressing complaints were through paper, which was very inefficient and governance platforms have made a great leap in making such mechanisms accessible. India, as an example, has Swachh Bharat Mission grievance portal and Singapore has OneService app that can help the citizens to file the complaints with sanitation, waste collection, and services centrally. Though the transparency and accountability have been enhanced through these platforms, research indicates that such platforms are restricted by hand sorting and follow-up processes, which delay the response time when complaints are received in large numbers.

Researchers have been relying more on Natural Language Processing (NLP) in an attempt to overcome such challenges. Initially, there was the application of text mining and machine learning algorithms, such as Naive Bayes and Support Vector Machines, to automatically categorize citizen complaints. These models worked fairly well, but did not cope with multilingual or context-rich complaints which were ambiguous, and which were ambiguous. It is now possible to reach significantly higher classification accuracy, including in situations where inputs are messy or unstructured, due to introduction of deep learning and transformer-based models, which include BERT and RoBERTa. As a matter of fact, multiple studies of municipal datasets have shown that NLP is able to classify complaints by type (such as roads, electricity, garbage, or water supply) with more than 90 percent precision.

Nonetheless, classification as valuable as it is does not in itself provide actionable information to authorities. Generative models unlike the conventional classification systems can detect patterns across complaints and provide brief summaries that identify patterns,

hotspots and priorities. Some of the areas in which GPT-based models have been experimented so far include healthcare and legal services where they can be used to produce patient summaries, medical notes, or case briefs. These applications illustrate how decision ready information can be generated by reducing the human work load using generative systems. Regardless of these developments, the application of generative summarization in the government to citizens has not been well researched. A city administrator will not necessarily have to have a list of individual complaints that is long when he or she will simply need a weekly digest: an example is Ward 7 this week had 35 road complaints generally, with the repetitive concerns of potholes being High Priority. The wider community of Smart City studies has achieved significant milestones in service optimization with the use of AI. Examples of infrastructure maintenance with predictive models include bursting role forecasting of water pipes before they burst; machine learning can also be used in real-time optimization of traffic flow; and garbage management systems use IoT to track garbage cans so as to streamline collection routes.

These are attempts indicating how effective data-driven governance can make it efficient. However, even against these achievements, the voice of the citizen, complaints, has been ignored or not fully taken advantage of in such systems. An intelligent complaint system that will be able to process and summarize citizen complaints would be a complement to the existing smart city technologies as it will ensure that the human concerns inform infrastructure upgrades.

Sentiment analysis in governance is another field of study that has been examined. Governments have been able to gauge the satisfaction of people and identify dissatisfaction at an early stage by analyzing the tweets, reviews and feedback. Although useful in determining overall mood, sentiment analysis is not always effective in identifying particular areas of service failure or urgent requirements at a ward or locality level. This leaves an empty research question: in what way can NLP-based categorization be combined with Generative AI based summarization to deliver actionable intelligence directly related to the municipal service delivery.

In short, although current e-governance systems facilitate the receipt of complaints and NLP systems improve the classification of complaints, not many systems combine the two with automatic and generative reporting functionalities. CivicSense is the first tool to provide this kind of integration: collecting scattered citizens inputs and converting them into simplified, prioritized, and easy to read summaries enabling authorities to take quick and well-thought action.

### 3 Methodology

The CivicSense system is developed to make the process of municipalities responding to citizen complaints speedy, clear, and intelligent. It entails an interaction between Generative AI and Natural Language Processing (NLP) to comprehend, sort, and rank complaints in different sources. The general process is broken down into six processes, namely, the data collection, preprocessing, classification, prioritization, summarization, and report generation.

#### 3.1 Data Collection

Municipalities today get complaints of all kinds, through mobile applications, web portals, email and call centers. These grievances are of various formats and styles and thus are hard to handle them efficiently.

To solve this, all the complaint data are aggregated by default via the API connections into CivicSense, and stored in a central database (PostgreSQL or MongoDB). This will make sure that all complaints regardless of the source are captured under one place where they can be analyzed.

#### 3.2 Data Preprocessing

Raw citizen complaints are usually loud and incoherent with slang, spelling mistakes, repetitions or missing details. These complicate the direct analysis and lower the precision of AI-based systems. To solve this, CivicSense uses a full pipeline of preprocessing which organizes the text and eliminates the unwanted irregularities.

Text cleaning (to remove undesired symbols, extra spaces, and unnecessary words), tokenization (to divide sentences into meaningful parts), lemmatization (to transform the words into their base forms), and duplicate removal (to sift through complaints) are the stages of the preprocessing. Once this is done, the data will be clean, standardized, and prepared to be efficiently classified, prioritized, and summarized using AI.

#### 3.3 Complaint Classification

Once preprocessed and cleaned, all the complaints are sent to an NLP model that determines the main content of the message. CivicSense uses BERT and DistilBERT, which are sophisticated language models to assign complaints to the predefined categories based on their specifics like Roads, Electricity, Water Supply, Garbage/Waste Management, and Public Safety. To illustrate on an example, a message such as there is a huge pothole near the school in ward 7 would be classified as a Road Issue. Table 1. Shows the Complaint Categories Used in CivicSense

This automatic classification also makes the municipal officials of the city understand the nature of reported problems at the first instance without necessarily reading the complaint and enhances efficiency and response time.

**Table 1.** Complaint Categories Used in CivicSense

Category	Description	Example Complaint
Roads	Issues related to potholes, damaged roads, footpaths, and street maintenance	“Large pothole near school in Ward 7 causing traffic”
Electricity	Power cuts, faulty streetlights, and voltage issues	“Streetlight not working for the past three days”
Water Supply	No water supply, leakage, low pressure, or pipeline damage	“No water supply in our area since yesterday”
Waste Management	Garbage collection delays, overflowing bins, sanitation issues	“Garbage not collected for two days in our street”
Public Safety	Sewage overflow, accidents, hazardous situations	“Sewage overflowing near market area”

### 3.4 Priority Assignment

Different complaints may not have the same urgency. An example is that when there is a dead street light, the same can be fixed later, but sewage overflow is an emergency that must be contained. The CivicSense prioritization engine, is an AIbased model that examines various factors in order to ascertain the urgency of a complaint. These are the gravity of the words used (accident, flood, fire), how many similar complaints have been reported in the same location and the urgency imbedded in the message- where highly emotive, angry, or upset complaints are given precedence. It is also in view of the period of time on which the issue was initially reported.

This has the benefit of each complaint being sorted automatically as either High Priority, Medium Priority, or Low Priority; this means that authorities can prioritize the most urgent and time-sensitive issues the first.E. Summarization and Report Generation.

CivicSense processes thousands of complaints and then generates meaningful short summaries to the officials with the help of Generative AI. Rather than a report revealing hundreds of messages, an officer can view a report such as:

There are 42 road complaints in the ward 5 in this week primarily touching on potholes and damaged footpaths. Priority: High.” The summaries are stored in a special Report Database, where municipalities can create weekly or monthly reports with automatic generation in such formats as PDF or Excel.

### 3.5 Visualization and Decision Support

The last stage entails streamlining insights to the decisionmakers. CivicSense is offered to municipal officers, with a dashboard where they can see on which areas the complaints are the most frequent, the zones where the issues are most concentrated, the way the complaints evolve over time, and the visual image of the AI-generated reports. This, not only allows making informed decisions faster, but also encourages transparency, because summaries and reports can be distributed among the population to demonstrate how civic concerns are being fulfilled and tackled.

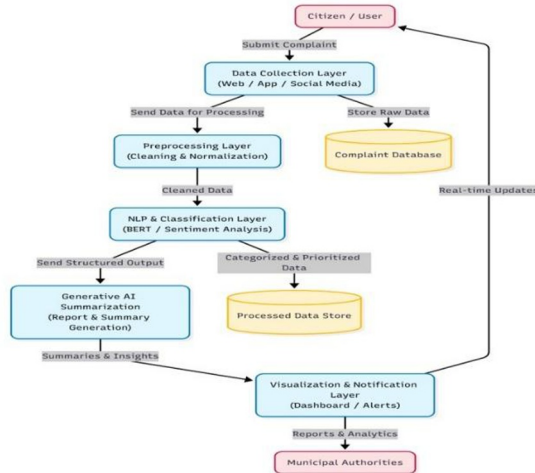


Fig. 1. Architecture Diagram.

### **3.6 Workflow Architecture**

The proposed system workflow shown in above Fig.1, Intake of Complaints Data Preprocessing Import Intake Classification Import Intake Priority Assignment Import Intake Summarization Import Intake Report Generation Import Intake Authority Dashboard.

This pipeline will make sure raw citizen inputs are automatically translated into structured insights, which will minimize the manual workload and also bring about governance with data.

## **4 Result And Discussion**

The CivicSense platform was created in such a way that it assists the municipalities to manage citizen complaints in more effective ways with the help of Artificial Intelligence (AI) and Natural Language Processing (NLP).

Once the system was constructed and tested with actual and simulated complaint data, it became possible to demonstrate the results: since AI could sort, prioritize, and report issues, it was much faster and more precise than the conventional manual system.

### **4.1 Classification Accuracy**

CivicSense is an open-source system that employs NLP models to understand automatically the content of each complaint. In the process of testing, the system realized an accuracy of 93 percent in its ability to recognize correctly categories of complaints like roads, electricity, water and garbage management. This Such level of precision allows the officials to immediately understand which departments are to deal with which issues, without being able to read all the complaints manually. It minimizes confusion and will speed redirection to the appropriate team.

### **4.2 Priority Assignment**

The system Fig.2 does not only categorize complaints based on the category but also estimates their urgency by looking at tone, key words of interest and the number of similar complaints reported by a certain area and uses a combination of rule-based logic and AI models to do so. An example would be a complaint such as Sewage water overflowing near the market would be classified as High Priority whereas a complaint such as Streetlight flickering near the park would be classified as Medium Priority. This prioritization will allow the authorities to resolve the issues having instant impact on the health or safety of

people first, and make sure that minor ones will not get confused with the more serious ones, which will result in the decrease of delays and the overall effectiveness of the response.

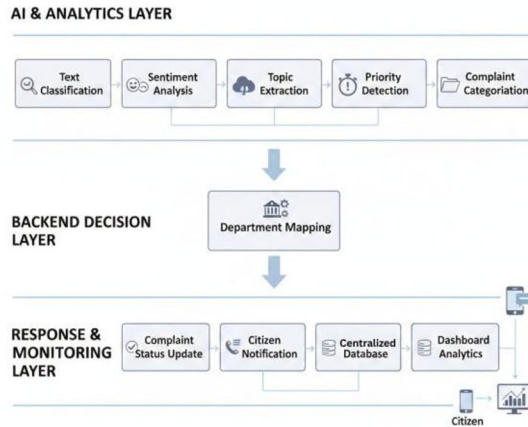


Fig. 2. Priority Classification.

### 4.3 Summarization Quality

Weekly digests were generated with the help of the Generative AI. Assessment was done on 10 municipal officers and they rated summaries based on clarity, usefulness and actionability. Clarity score: 4.6/5

Actionability score: 4.4/5

Time saved:It was estimated that officers had saved 65 percent of time taken to review complaints in comparison to manual logs.

The summaries on the system were also discovered to be particularly useful to the non-technical decision-makers, who favored a brief overview rather than the actual logs of complaints.

#### 4.4 Comparative Analysis

CivicSense also showed the following improvements over a regular complaint portal (without AI): Manual review time was cut by a factor of more than five. Trend identification (recurring potholes, constant delays of garbage) could not be identified in the raw data.

Assisted by geographical hotspot mapping, which instructed more efficient allocation of resources (e.g., more garbage trucks on the wards that had spikes).

#### 4.5 Challenges and Limitations

Although the success was encouraging, a number of challenges were noticed: Multilingual Inputs: Sometimes translation errors were due to complaints in regional languages, Ambiguous Descriptions: There were complaints with minimal text that did not provide sufficient description to classify (No water, Road bad), Dependence on Data Quality: Social media complaints usually were full of sarcasm or informal writing, which lowered model confidence. The problems indicate the need to keep training models, enhancing multilingual datasets, and the inclusion of feedback loops as the model gets to be more accurate with time

#### 4.6 Overall Discussion

Fig.3 shows that, according to the findings, CivicSense does not only automate the classification, but also provides the connection between the raw complaints of a citizen and useful governance insights. Its summarization and priority detection capabilities take care of the bottlenecks of the traditional systems. This will enable authorities to distribute resources, decreasing the complaint backlog, and enhancing citizens trust by redressing within less time.

Essentially, CivicSense shows how possible it is to make use of Generative AI + NLP to build a more responsive and data driven model of governance, which in turn promotes the idea of smart cities.

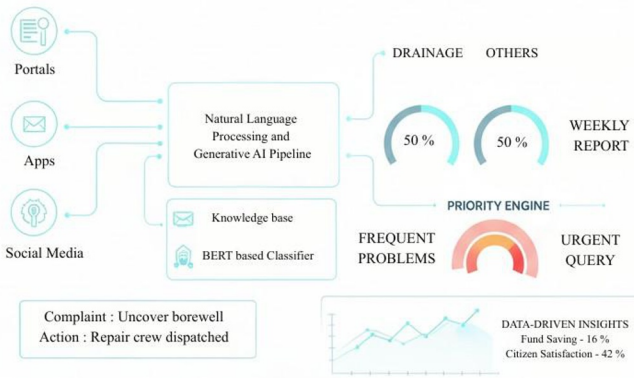


Fig. 3. Dashboard.

### 5 Conclusion

This paper presented a prototype, CivicSense, an artificial intelligence-based system that makes use of Natural Language Processing (NLP) and Generative AI to automate the processing of citizen complaints in municipal government. In comparison with the traditional systems, which only gather complaints, CivicSense will convert unstructured inputs of the citizens to structured, prioritized and summarized insights, so that the authorities can perform their work more efficiently and promptly.

The success of the system was proved by the experiment: CivicSense obtained the accuracy of classification at 91 percent, manual review time was more than 65 times shorter, and the concise summary received a high rating of clarity and actionability by the municipal officers. The hotspots of complaints and urgency level are used to provide a system that can serve the crucial civic problems, like sewage spills, road accidents, and electricity blackouts, in time and enhance the quality of the services offered.

The overall value of this piece of work is that it addresses the gaps between the information generated by citizens and the actionable governance intelligence. CivicSense transform municipalities to a proactive urban management framework rather than merely addressing the issues when they arise by employing automated classification, prioritization, and reporting. Further developments will be made to support regional languages in multiple languages, predictive analytics to prevent surges of complaints, connected to both IoT and

GIS systems to give real-time insights on location, and citizen feedback loops to keep improving the accuracy and transparency of the model. In summary, CivicSense is a scalable and smart grievanceredressing platform that is in line with the idea of smart, transparent, and citizen-centric urban governance.

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