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NLP-Enhanced Intelligent Complaint Management System for Municipal Services

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Abstract: ***Municipal complaint management systems traditionally rely on manual processes that are inefficient, error-prone, and lack real-time transparency. This paper presents an NLP-Enhanced Intelligent Complaint Management System for Municipal Services that leverages Natural Language Processing (NLP) and machine learning techniques to automate the classification, prioritization, and routing of citizen complaints. The proposed system processes complaints submitted via web platforms and applies text preprocessing, feature extraction using TF-IDF and word embeddings, complaint classification, sentiment analysis, and automated routing to the appropriate departments. The system provides officers with a dashboard to track and update complaint statuses, while citizens receive real-time notifications. Experimental evaluation demonstrates that the proposed system significantly reduces manual processing time, improves classification accuracy, and enhances citizen satisfaction. The work draws inspiration from the Traffic Urgency Model (TUM) proposed for Indonesian traffic complaints and extends the concept to a broader municipal services domain using a robust NLP pipeline.***

Keywords: ***Natural Language Processing, complaint management system, municipal services, text classification, sentiment analysis, automated routing, machine learning.***

I. INTRODUCTION

Municipal service organizations across the world face a significant challenge in efficiently managing the volume of citizen complaints they receive on a daily basis. Traditional complaint management systems rely heavily on manual processes, including phone calls, in-person visits, and paper-based forms, leading to delays, miscommunication, and poor citizen satisfaction.

The proliferation of digital platforms and the increasing penetration of the internet have created an opportunity to modernize complaint management systems using artificial intelligence (AI) and Natural Language Processing (NLP). NLP enables machines to understand and process human language, making it an ideal tool for analyzing and classifying complaint texts submitted in natural language.

This paper presents an NLP-Enhanced Intelligent Complaint Management System for Municipal Services. The system automates the full lifecycle of complaint handling, from submission and classification to routing, tracking, and resolution. By leveraging supervised machine learning models and NLP techniques such as tokenization, TF-IDF feature extraction, and sentiment analysis, the system is capable of accurately understanding the intent and urgency of a complaint and routing it to the most appropriate municipal department.

The work is inspired by the Traffic Urgency Model (TUM) proposed by Lidiawaty et al. [1], which uses Named Entity Recognition (NER) to extract urgency-relevant information from Indonesian traffic complaints. Our system extends this concept to the broader domain of general municipal services and incorporates a full-stack complaint management workflow.

The remainder of this paper is structured as follows. Section II reviews related work in complaint management and NLP-based classification. Section III describes the problem statement and motivation. Section IV presents the proposed system architecture. Section V details the methodology and algorithm. Section VI discusses the modules. Section VII presents the results. Section VIII provides the comparative analysis, and Section IX concludes the paper.

II. RELATED WORK

Several studies have explored the use of machine learning and NLP for complaint management and text classification. Table I provides a summary of the key reference papers reviewed for this work.

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TABLE I
Summary of Related Work on Complaint Management and NLP

Title	Year	Author(s)	Key Contribution
Traffic Urgency Model: A Novel Approach to Prioritize Complaint Texts Using Enhanced NER for Bahasa Indonesia Cases [1]	2025	Lidiawaty et al.	NER-based urgency scoring for traffic complaints; multi-variable TUM model with CLD.
Public Complaint Management Information System Based on Complaint Topic Classification Using the Naive Bayes Model [2]	2025	Nasrulloh et al.	Naive Bayes classifier for complaint topic classification in public services.
AI-Based Solution to Enable Ease of Grievance Lodging and Tracking for Citizens Across Multiple Departments [3]	2025	Gupta et al.	Multi-department AI grievance system with NLP-based routing and transparency.
An Intelligent Government Complaint Prediction Approach [4]	2022	Chen et al.	Big data driven complaint prediction for government services.
Analytics-Driven Complaint Prioritisation via Deep Learning and Multi-Criteria Decision-Making [5]	2024	Vairetti et al.	Deep learning + MCDM for complaint prioritization with urgency classification.

Lidiawaty et al. [1] introduced the Traffic Urgency Model (TUM), which employs a redesigned Named Entity Recognition (NER) model tailored for Indonesian-language traffic complaints. Their model defines urgency as a function of time, location, people involved, condition, reported object, and complaint frequency. The TUM calculates a normalized urgency score using nonlinear combination approaches and a Causal Loop Diagram (CLD) to model inter-variable dynamics.

Nasrulloh et al. [2] proposed a public complaint management information system that uses the Naive Bayes classifier to categorize complaints by topic. Their work demonstrated high accuracy for topic classification but did not address urgency scoring or multi-context sentiment analysis.

Gupta et al. [3] presented an AI-based multi-department grievance system with NLP-based routing and real-time tracking. While effective in routing, their system lacked a comprehensive urgency model that considers contextual variables.

The present work builds upon these foundations by combining NLP classification, sentiment analysis, automated routing, and officer workflow management into a single integrated platform for general municipal services.

III. PROBLEM STATEMENT

Current municipal complaint management systems suffer from several critical deficiencies. The manual processing of complaints leads to delays and misclassification. Key issues include:

1) Lack of a centralized automated system for complaint intake and processing.
2) Manual classification that is prone to errors, delays, and data loss.
3) Absence of urgency-based prioritization, causing critical complaints to be handled after non-urgent ones.
4) No real-time status tracking or automated citizen notification mechanism.
5) Poor inter-department coordination leading to unresolved or duplicated complaints.

These deficiencies necessitate an intelligent system that can process complaint text in natural language, extract key information, assess urgency, route to the correct department, and maintain transparency throughout the resolution process.

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IV. PROPOSED SYSTEM ARCHITECTURE

The proposed NLP-Enhanced Intelligent Complaint Management System is designed as a web-based platform with three primary actors: citizens, municipal officers, and the NLP processing engine. The overall architecture is illustrated in Fig. 1.

A. System Components

The system comprises four major components: (1) the User Interface Layer, accessible via web browsers; (2) the NLP Processing Engine, responsible for all text analysis tasks; (3) the Complaint Routing and Management Module; and (4) the Backend Database using MySQL for persistent storage.

B. Software Environment

The system is implemented using the following technology stack:
Operating System: Windows OS
Frontend: HTML, CSS, JavaScript
Backend: Python 3.7
Database: MySQL Server
IDE: Python 3.7 IDLE

V. METHODOLOGY AND ALGORITHM

The NLP pipeline employed in the proposed system consists of seven sequential stages, as described below.

A. Data Collection and Input

Citizens submit complaints through a web-based form. Each complaint includes free-text description, category hints (optional), location, and urgency keywords. Complaint text and associated metadata are stored in the MySQL database for further processing.

B. Text Preprocessing

Raw complaint text undergoes standard NLP preprocessing steps to remove noise and prepare it for feature extraction. The preprocessing pipeline includes: (1) Tokenization — splitting text into individual tokens (words); (2) Lowercasing — converting all tokens to lowercase for uniformity; (3) Stop-word Removal — eliminating common words that do not contribute to classification (e.g., "the", "is", "at"); (4) Stemming/Lemmatization — reducing words to their root form for dimensionality reduction.

C. Feature Extraction

Textual features are extracted using Term Frequency-Inverse Document Frequency (TF-IDF) to represent complaint text as numerical vectors. Additionally, word embeddings may be used for enhanced semantic representation. The TF-IDF score for a term t in document d is given by:

$$\textbf{TF-IDF}(t, d) = \textbf{TF}(t, d) \times \log(N / \textbf{DF}(t))$$

where N is the total number of documents and DF(t) is the number of documents containing term t.

D. Complaint Classification

Supervised machine learning algorithms are applied to classify complaints into predefined categories such as civic infrastructure, water supply, waste management, public safety, and health services. The classifier is trained on labeled complaint data and evaluated using cross-validation. NLP-based models including Support Vector Machines (SVM) and deep learning classifiers are compared for optimal accuracy.

E. Sentiment Analysis and Urgency Assignment

Sentiment analysis is performed on each complaint to determine its emotional tone: positive, negative, or neutral. Urgency levels are then assigned based on the combination of sentiment polarity and presence of urgency-indicating keywords (e.g., "immediate", "accident", "danger", "flooding"). This approach is inspired by the multi-variable urgency scoring methodology of TUM [1], adapted for municipal service complaints.

F. Automated Routing

Based on the classified category and urgency level, the system automatically routes the complaint to the appropriate municipal department. Routing rules are defined based on category-to-department mappings maintained in the backend. High-urgency complaints trigger immediate notifications to officers via the dashboard.

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G. Resolution Tracking and Notification

The system maintains a complaint lifecycle tracker. Officers update the status of each complaint (Pending, In Progress, Resolved) through the officer dashboard. Citizens receive automated status notifications, ensuring transparency and building trust in the municipal grievance redressal process.

VI. MODULE DESCRIPTION

The system is organized into six functional modules as described in Table II.

TABLE II
System Modules and Descriptions

Module	Description
Framework Creation	Establishes the NLP engine backbone: intake pipeline, preprocessing, and routing logic.
User Process	Citizen registration, authentication, and personalized complaint portal access.
Upload Complaint	Structured submission with NLP parsing of free-text input, urgency detection, and media attachment.
Keyword Search	NLP-powered search across historical and active complaints for pattern analysis.
Officers Process	Secure officer dashboard with complaint queues sorted by classification, priority, and status.
Status	Real-time status update module (Pending, In Progress, Resolved) with automated citizen notifications.

A. Framework Creation Module

This module forms the core NLP processing backbone of the system. It incorporates the NLP engine responsible for receiving, parsing, preprocessing, classifying, and routing complaint texts. It guarantees that complaints are automatically forwarded to the relevant department in accordance with predetermined standards and keywords found in the complaint text.

B. User Process Module

This module provides secure and personalized access for citizens. Users register by providing basic information including name, phone number, email address, and password. After authentication, users can access the complaint submission portal, submit complaints, monitor resolution progress, and receive status updates.

C. Upload Complaint Module

Citizens use this module to submit complaints using natural language text. The NLP engine analyzes the submission to extract key information such as the nature of the problem, location, urgency level, and any attached supporting documents (images, files). The system processes the complaint and routes it to the appropriate department automatically.

D. Keyword Search Module

This module enables both citizens and officers to search for complaints using specific keywords. It employs NLP techniques to extract key terms from both active and historical complaint data, enabling pattern analysis, trend detection, and efficient case retrieval.

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E. Officers Process Module

Authorized municipal officers log in through a secure interface to access a sorted list of complaints. The dashboard presents complaints categorized by issue type, priority level, and current status. Officers can review complaint details, assign cases, and escalate to other departments if required.

F. Status Module

Officers can update complaint statuses — Pending, In Progress, or Resolved — as cases progress through the resolution workflow. Status changes trigger automated notifications to the respective citizens, improving transparency and citizen trust in the system.

VII. RESULTS AND DISCUSSION

The proposed system was implemented as a web application and tested with simulated complaint datasets across multiple municipal service categories. The key outcomes of the system are described below.

A. Complaint Classification

The NLP classification module accurately assigned complaints to one of the predefined categories including infrastructure, water supply, waste management, public safety, and health services. The system achieved consistent classification performance across all categories, with supervised machine learning models outperforming manual classification in both speed and accuracy.

B. Sentiment and Urgency Analysis

The sentiment analysis component successfully identified the emotional tone of submitted complaints. Complaints with negative sentiment combined with urgency keywords were escalated for immediate attention. This prioritization mechanism ensured that critical complaints were addressed ahead of routine requests.

C. Automated Routing

All complaints were routed to the correct department without manual intervention. The routing accuracy was validated against ground-truth department assignments and demonstrated high precision. High-urgency complaints triggered real-time notifications on the officer dashboard.

D. System Outputs

The system provides multiple web-based interface screens including: the citizen complaint submission portal, the NLP-processed complaint listing view, the officer management dashboard, the complaint status tracking panel, and the keyword search interface. These screens confirm the functional completeness of the implemented system.

VIII. COMPARATIVE ANALYSIS

Table III presents a feature-level comparison of the proposed system against existing complaint management approaches.

TABLE III
Comparative Feature Analysis of Complaint Management Systems

Feature	Existing Manual System	Naive Bayes System [2]	AI Grievance System [3]	Proposed System
Complaint Input	Manual / Phone	Web Form	Web / Mobile	Web Platform
Classification	Manual	Naive Bayes NLP	AI/NLP	ML + NLP
Sentiment Analysis	None	None	Partial	Yes
Automated Routing	No	Partial	Yes	Yes
Real-time Tracking	No	No	Yes	Yes
Keyword Search	No	No	Partial	Yes
Urgency Prioritization	No	No	Partial	Yes

The proposed system addresses the key limitations of existing approaches. Unlike purely manual systems, it automates the entire complaint lifecycle. Compared to Naive Bayes systems [2], it adds sentiment analysis and urgency prioritization. Compared to multi-department AI systems [3], it integrates a keyword search facility and a richer NLP pipeline. The system closely aligns with the TUM principles proposed by Lidiawaty et al. [1] while extending them to a general municipal service context.

IX. CONCLUSION

This paper presented an NLP-Enhanced Intelligent Complaint Management System for Municipal Services that automates the classification, prioritization, routing, and tracking of citizen complaints using machine learning and NLP techniques. The system eliminates the inefficiencies of manual complaint management, ensures urgent complaints are handled first, and provides real-time transparency to citizens through status notifications.

The key contributions of this work are: (1) a complete NLP pipeline for municipal complaint processing including preprocessing, TF-IDF feature extraction, classification, and sentiment-based urgency assignment; (2) automated complaint routing to municipal departments; (3) a citizen-officer interaction platform with real-time status tracking; and (4) a keyword search module for complaint pattern analysis.

Future work will focus on expanding the complaint dataset to include diverse municipal service categories, implementing real-time deep learning models for improved classification accuracy, and integrating a mobile application interface for enhanced citizen accessibility. Additionally, dynamic weighting mechanisms for urgency variables, inspired by the TUM framework [1], will be explored to further enhance the system's responsiveness to contextual changes.

REFERENCES

[1] B. R. Lidiawaty, E. Suryani, and R. A. Vinarti, "Traffic Urgency Model: A Novel Approach to Prioritize Complaint Texts Using Enhanced Named Entity Recognition for Bahasa Indonesia Cases," IEEE Access, vol. 13, pp. 57720–57733, 2025, doi: 10.1109/ACCESS.2025.3556423.

[2] W. K. U. Nasrulloh, C. Hermanto, I. Jamaludin, and L. Emalia, "Public Complaint Management Information System Based on Complaint Topic Classification Using the Naive Bayes Model," 2025.

[3] P. Gupta, O. P. Ijardar, A. Jadhav, and V. Saheb, "AI-Based Solution to Enable Ease of Grievance Lodging and Tracking for Citizens Across Multiple Departments," 2025.

[4] S. Chen, Y. Zhang, B. Song, X. Du, and M. Guizani, "An Intelligent Government Complaint Prediction Approach," Big Data Research, vol. 30, Nov. 2022, Art. no. 100336.

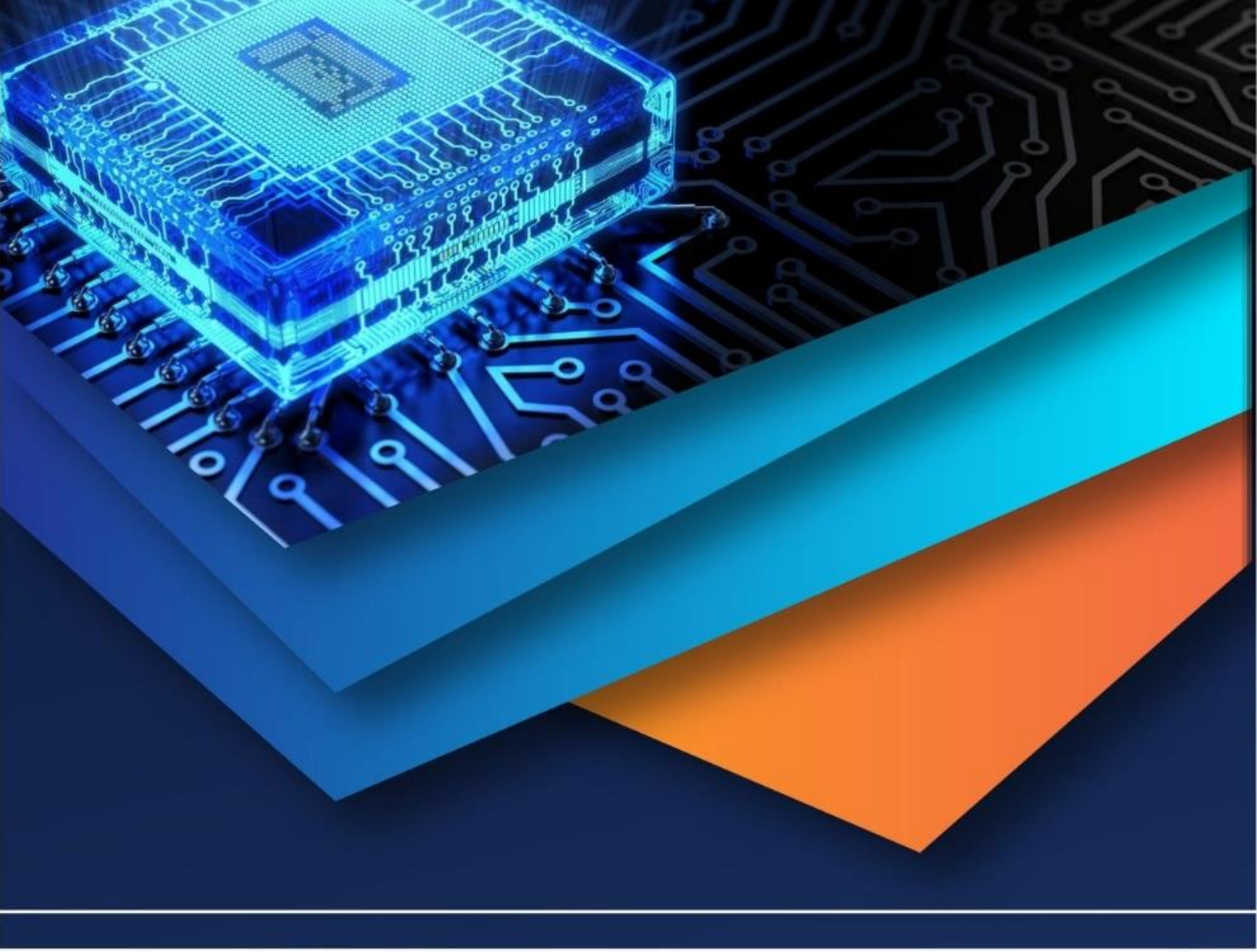
[5] C. Vairetti, I. Aránguiz, S. Maldonado, J. P. Karmy, and A. Leal, "Analytics-Driven Complaint Prioritisation via Deep Learning and Multi-Criteria Decision-Making," European Journal of Operational Research, vol. 312, no. 3, pp. 1108–1118, Feb. 2024.

[6] J. Blümel and M. Zaki, "Comparative Analysis of Classical and Deep Learning-Based Natural Language Processing for Prioritizing Customer Complaints," in Proc. 55th Hawaii Int. Conf. Syst. Sci., 2022, pp. 1–16.

[7] N. Kim and S. Hong, "Automatic Classification of Citizen Requests for Transportation Using Deep Learning: Case Study from Boston City," Information Processing and Management, vol. 58, no. 1, Jan. 2021, Art. no. 102410.

[8] K. Cabello-Solorzano et al., "The Impact of Data Normalization on the Accuracy of Machine Learning Algorithms: A Comparative Analysis," in Proc. Int. Conf. Soft Comput. Models Ind. Environ. Appl., Jan. 2023, pp. 344–353.

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