Smart Complaint Tracking System

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***Abstract*—Efficient complaint management plays a vital role in improving service quality and public satisfaction in modern organizations and smart governance systems. However, traditional complaint handling methods are often manual, time-consuming, and lack transparency, leading to delayed responses and unresolved grievances. To address these challenges, this paper proposes a Smart Complaint Tracking System using Machine Learning techniques. The system automatically analyzes user-submitted complaints using Natural Language Processing and classifies them into appropriate categories with the help of TF-IDF feature extraction and machine learning algorithms such as Logistic Regression, Support Vector Machine, and Random Forest. Experimental results show that the proposed system improves complaint classification accuracy, reduces response time, and enhances transparency in complaint resolution. The system can be effectively deployed in smart cities, government services, and large-scale organizations.**

I. INTRODUCTION

The rapid growth of online services, smart cities, and e-governance platforms has led to a significant increase in user complaints related to public services, infrastructure, and organizational operations [13], [18]. Manual complaint handling systems struggle to manage this growing volume efficiently, often leading to improper routing, lack of accountability, and poor user experience [12], [14]. As a result, many genuine complaints remain unresolved for long periods.

Machine Learning provides an effective solution by automatically analysing complaint text and identifying meaningful patterns for accurate classification [2], [8]. Intelligent complaint tracking systems reduce human intervention, improve accountability, and ensure faster grievance redressal [3]. This project focuses on developing a smart complaint tracking framework that can be effectively used in real-world governance and organizational environments [19].

II. MAIN OBJECTIVES

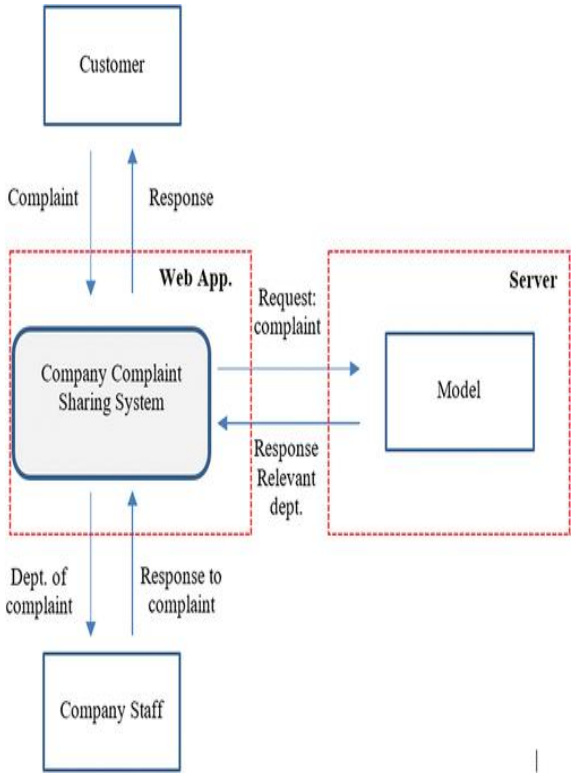
The main objective of this project is to design and develop an intelligent Smart Complaint Tracking System that can automatically manage and classify user complaints using machine learning techniques. The system aims to reduce manual intervention by analysing complaint text and accurately categorizing it into relevant service domains, thereby ensuring faster routing and efficient grievance redressal [2], [3]. By automating the complaint handling process, the system seeks to improve operational efficiency and minimize delays commonly observed in traditional complaint management systems [12].

Another key objective is to enhance transparency and accountability in complaint resolution by providing real-time tracking and status updates to users. The system enables users to monitor the progress of their complaints through a unique tracking ID, while administrators can evaluate resolution performance using centralized dashboards [14], [16]. This objective helps build trust between service providers and users and ensures timely responses to reported issues [13].
Additionally, the project aims to evaluate the effectiveness of multiple machine learning algorithms such as Logistic Regression, Support Vector Machine, and Random Forest in complaint classification tasks. By comparing their performance, the system identifies the most reliable model for real-world deployment and scalability [5], [6], [20]. Overall, the objective is to create a scalable, user-friendly, and intelligent complaint management framework suitable for smart governance and organizational service platforms [18], [19].

III. SYSTEM OVERVIEW

The Smart Complaint Tracking System is designed to automate the process of registering, classifying, and managing user complaints in an efficient and transparent manner. Users can submit complaints through a web or mobile interface, where the system captures the complaint details in text format. The submitted complaint is first pre-processed to remove unnecessary symbols and common words, after which TF-IDF is applied to convert the complaint text into numerical feature vectors suitable for machine learning analysis [4], [7].

Once the features are extracted, machine learning algorithms such as Logistic Regression, Support Vector Machine (SVM), and Random Forest are used to classify the complaints into predefined categories based on their content [2], [5], [6]. The classified complaint is then automatically assigned to the appropriate department using a rule-based mapping mechanism. All complaint details, along with their categories and current status, are securely stored in a centralized database, enabling efficient management and retrieval of information [14], [16].



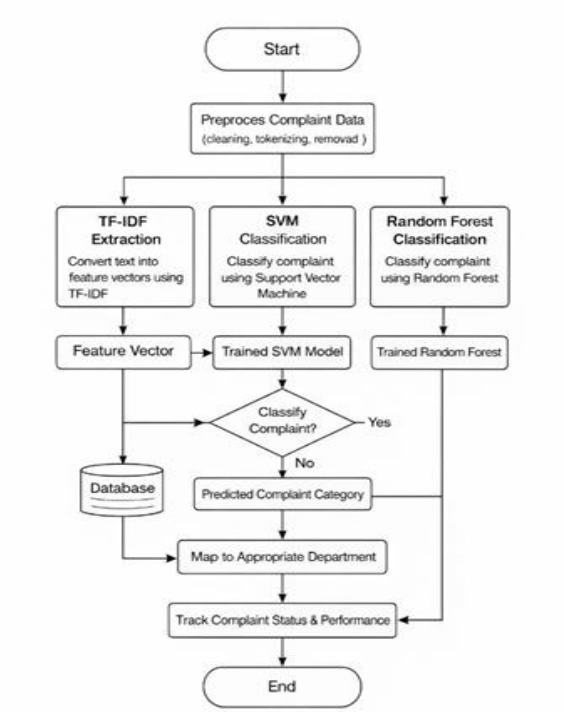
The system also provides real-time complaint tracking and monitoring features for both users and administrators. Users can check the status of their complaints using a unique tracking ID, while administrators can analyse resolution performance through dashboards and reports [3], [12]. By automating complaint handling and providing transparent tracking, the system improves response time, accountability, and overall service quality, making it suitable for smart governance and organizational applications [13], [18].

IV. SYSTEM ARCHITECTURE

The system architecture of the Smart Complaint Tracking System describes the structured flow of complaint data from submission to resolution. The process begins at the user interface layer, where users submit complaints through a web or mobile application. These complaints are forwarded to the preprocessing module, which performs text cleaning operations such as tokenization, removal of stop words, and normalization to prepare the data for analysis. After preprocessing, the TF-IDF feature extraction technique converts the complaint text into numerical feature vectors that capture the importance of relevant terms [4], [7], [15].

The extracted features are then processed by the machine learning layer, where algorithms such as Logistic Regression, Support Vector Machine (SVM), and Random Forest classify the complaints into predefined categories based on their content [2], [5], [6]. Once classified, a rule-based mapping mechanism assigns the complaint to the appropriate department, and all details are stored in a centralized database. The administration layer enables real-time tracking, monitoring, and performance analysis, ensuring transparency, accountability, and efficient grievance redressal [3], [12], [16].

V. ALGORITHM



This project uses three main techniques to implement the Smart Complaint Tracking System: TF-IDF, Support Vector Machine (SVM), and Random Forest [4], [5], [6]. These techniques work together to convert user complaint text into meaningful numerical representations and accurately classify complaints into appropriate service categories. The automated classification process reduces manual effort and improves the efficiency of complaint routing and resolution [3], [12].

TF-IDF (Term Frequency – Inverse Document Frequency)

TF-IDF is used to measure the importance of words within a user complaint [4], [15]. Words that frequently appear in certain complaints, such as power cut, water leakage, or road damage, are assigned higher weights, while commonly used words receive lower importance [7]. This helps the system identify key terms that indicate the nature of the complaint.

$$\mathrm{TF}(t, d) = \frac{\text{count of term } t}{\text{total terms in document } d}$$

Where:

- t = count of term in the document
- d = total number of words in the document

Inverse Document Frequency (IDF):

$$\mathrm{IDF}(t) = \log\left(\frac{N}{df(t)}\right)$$

Where:

- N = total number of documents
- df(t) = number of documents containing term t

TF-IDF Weight:

$$\text{TF-IDF}(t, d) = \mathrm{TF}(t, d) \times \mathrm{IDF}(t)$$

TF-IDF ensures that the model focuses on meaningful and discriminative complaint terms rather than common words such as the or and [4].

Support Vector Machine (SVM)

Support Vector Machine (SVM) is used as the primary classification algorithm for categorizing user complaints [5]. SVM identifies an optimal hyperplane that separates different complaint categories while maximizing the margin between them. This makes SVM highly effective for handling high-dimensional and sparse TF-IDF feature vectors.

$$f(x) = w^T x + b$$

By maximizing the margin, SVM improves generalization and reduces misclassification of similar complaints, making it suitable for real-world complaint tracking systems [5], [18].

Random Forest

Random Forest is an ensemble learning algorithm that improves classification accuracy by combining multiple decision trees [6], [20]. Each decision tree independently predicts the complaint category, and the final classification is determined using majority voting.

$$f(x) = \mathrm{mode}\{h_1(x), h_2(x), \ldots, h_k(x)\}$$

Random Forest performs well with noisy and unstructured complaint data, as it captures complex patterns and reduces overfitting compared to single classifiers [6].

VI. RESULT AND DISCUSSION

The Smart Complaint Tracking System was evaluated using a dataset of user-submitted complaints collected from different service domains. The dataset was divided into training and testing sets to assess the performance of the machine learning models. TF-IDF was used for feature extraction, and the classification performance of Support Vector Machine (SVM) and Random Forest was analysed. Experimental results

show that both models achieved high accuracy in categorizing complaints, with Random Forest slightly outperforming SVM due to its ensemble nature and ability to handle noisy and diverse complaint text. SVM demonstrated strong performance in handling high-dimensional TF-IDF feature vectors and produced consistent classification results.

The automated complaint classification significantly reduced manual intervention and improved routing efficiency. Complaints were accurately assigned to the appropriate departments, resulting in faster response times and improved grievance resolution. The discussion of results indicates that ensemble-based models such as Random Forest are more robust when complaint text varies in writing style, while SVM is effective in maintaining generalization across categories. Overall, the system enhances transparency, accountability, and operational efficiency, making it suitable for real-world deployment in smart governance and organizational complaint management systems.

VII. BENEFITS

The proposed Smart Complaint Tracking System offers several significant benefits for users, organizations, and service providers [1], [8]. One of the key advantages is improved efficiency in complaint handling, as the system automatically classifies and routes complaints to the appropriate departments, reducing delays caused by manual processing [12], [16]. By minimizing human intervention, the system ensures faster response times and helps prevent complaints from being overlooked or misdirected [3]. This automated approach also reduces the workload of administrative staff and improves overall operational effectiveness [20].

Another important benefit is enhanced transparency and user trust in the grievance redressal process [14], [18]. Users can track the status of their complaints in real time using a unique tracking ID, which improves accountability and satisfaction [13]. From an organizational perspective, the system enables better monitoring and analysis of complaint trends, helping decision-makers identify recurring issues and improve service quality [19]. Since the system is built using TF-IDF with machine learning models such as Support Vector Machine and Random Forest, it provides accurate, reliable, and scalable performance, making it suitable for real-time deployment in smart governance and large-scale service environments [19], [20].

VIII. DIFFICULTIES AND CHALLENGES FACED

One of the main difficulties in the Smart Complaint Tracking System is that users describe their problems in different ways. Many complaints are written casually, with spelling mistakes, short sentences, or missing details, which makes it hard for the system to clearly understand the issue [4], [15]. Sometimes, similar words are used for different types of complaints, which can confuse the system and slightly affect classification accuracy [5], [7].

Another challenge is managing a large number of complaints while keeping the system fast and secure. As complaints increase, the system must handle more data without slowing down [16], [18]. At the same time, user information must be kept safe, and the machine learning models need regular updates so they continue to work well as complaint patterns change over time [13], [20].

IX. CONCLUSION

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X. FUTURE ENHANCEMENTS

In the future, the Smart Complaint Tracking System can be improved by integrating advanced deep learning models such as BERT or LSTM to better

understand the context and meaning of user complaints [17]. These models can handle complex sentence structures and improve classification accuracy, especially when complaints are written in informal or mixed language. Adding multilingual support will also allow the system to process complaints from users with different language backgrounds, making it more inclusive and effective [11].

Further enhancements can include sentiment analysis to identify urgent or critical complaints and prioritize them accordingly [11], [18]. A mobile application with real-time notifications can improve user engagement and accessibility. Additionally, integrating analytics dashboards and cloud-based deployment will help organizations monitor complaint trends, improve decision-making, and scale the system efficiently for large-scale real-world applications [16], [20].

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