AI Driven Grievance Lodging and Tracking System

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Abstract. The Grievance Management System is a web-based platform designed to enhance the efficiency and transparency of handling public grievances. By introducing role-based access for users, moderators, and government officials, the system ensures that grievances are systematically reviewed, prioritized, and resolved. Users can submit grievances, track their status, and receive notifications regarding updates. Moderators are tasked with verifying the validity of each grievance and assigning it a priority level before passing it on to government officials for action. Government officials, in turn, have the ability to filter grievances by priority and submission date, helping them manage and resolve issues more effectively. The system integrates technologies such as Flask for back-end logic, MySQL for database management, and natural language processing (NLP) to classify grievances into relevant departments. It also prevents rejected grievances from being re- submitted and delivers real-time notifications to users, ensuring an efficient and transparent grievance handling process. This project aims to improve the accountability and responsiveness of government departments in addressing public complaints.

Keywords. Grievance Management, Role-Based Access, Web Application, Automated Classification, Government System.

1 INTRODUCTION

The "AI Driven Grievance Lodging and Tracking System" is an innovative platform developed to address the inefficiencies in traditional grievance redressal mechanisms. In many organizations and government bodies, handling public complaints and grievances can be a cumbersome and time- consuming process, often leading to delayed responses and lack of transparency. This project aims to leverage the power of artificial intelligence (AI) to automate the categorization, prioritization, and tracking of grievances, ensuring a faster and more efficient resolution process.

The system is designed with three key roles: users, moderators, and government officials. Users can easily lodge complaints through the system, describing their issues, which are then automatically analyzed by AI algorithms to classify them into relevant categories or departments. Moderators review these grievances to ensure they are legitimate and prioritize them based on urgency before forwarding them to government officials for action. The government officials then access a dashboard where they can filter grievances by priority, department, or submission date, allowing them to efficiently manage and address the complaints.

By introducing AI-driven automation, the system enhances accountability and reduces manual errors, improving response times and overall user satisfaction. Additionally, users can track the status of their grievances in real-time, ensuring transparency throughout the process. The system aims to build trust between the public and authorities by providing a clear, streamlined, and responsive grievance redressal mechanism.

2 RESEARCH METHODOLOGY

- **Problem Identification**: Addressing inefficiencies in existing grievance systems, such as slow processing, misclassification, and lack of tracking, by proposing an AI-powered solution.
- **Literature Review**: Studying current grievance redressal systems, identifying gaps, and exploring AI techniques like NLP for automated classification and prioritization.
- **System Design**: Creating a multi-role system (users, moderators, government officials) with modules for grievance submission, AI-based categorization, validation by moderators, and efficient tracking.
- **Technology Stack**: Implementing the system using Flask (backend), MySQL (database), and NLP libraries (for grievance classification), with user authentication and role-based dashboards.
- **Implementation**: Developing a web-based platform where users submit grievances, moderators validate and prioritize them, and government officials manage and resolve the issues.
- **Testing and Validation**: Conducting system tests, including unit tests, user acceptance testing (UAT), and performance evaluations to ensure system efficiency and usability.
- **Deployment and Evaluation**: Deploying the system for pilot testing, gathering metrics, and making further improvements to enhance grievance resolution and user satisfaction.

3 THEORY AND CALCULATION

NLP is a branch of artificial intelligence that deals with the interaction between computers and human languages. The primary goal of NLP in this system is to analyze and classify grievances into predefined categories such as health, education, transport, etc.

- **Tokenization**: This is the first step in the NLP pipeline, where the text of a grievance is broken into smaller pieces, called tokens. Each token could be a word or a sentence, depending on the type of tokenization used.

Example: The sentence, "The school has poor infrastructure," would be tokenized into: "The","school","has","poor","infrastructure".

- **Stopword Removal**: After tokenization, common words like "the," "is," "in," etc., are removed because they do not carry significant meaning in classification. This step reduces noise in the data.

Example: From the tokenized list, words like "the" and "has" are removed, leaving: "school","poor","infrastructure".

- **Text Classification**: Once tokenization and stopword removal are complete, the text is classified into categories using an AI-based model. Classification algorithms like **Naive Bayes**, **Support Vector Machines (SVM)**, or even **neural networks** can be employed.

The system implements **Role-Based Access Control (RBAC)** to ensure that each user only has access to actions and data relevant to their role. The three main roles in the system are:

- **Users**: Can submit grievances and track their status.
- **Moderators**: Review and validate grievances before forwarding them to government officials.
- **Government Officials**: Manage and resolve validated grievances based on priority and department.

The theory behind RBAC involves assigning permissions based on roles. The logic can be expressed as:

$$\text{Access} = \text{User\_Role} \cap \text{Permission}$$

Where a user's access to specific functionalities is the intersection of their role and the permission level required to access that functionality.

RBAC Example:

- A **user** can only view and manage their grievances.
- A **moderator** can view all grievances in the system but cannot resolve them.
- A **government official** can view and resolve grievances assigned to their department.

3.1 MATHEMATICAL EXPRESSIONS AND SYMBOLS

In a probabilistic model like Naive Bayes, the calculation involves determining the likelihood that a grievance belongs to a category based on the occurrence of certain words (tokens). The formula is:

$$P(\text{Category}|\text{Tokens}) = P(\text{Tokens}|\text{Category}) \times P(\text{Category}) / P(\text{Tokens}).$$

- **P(Category|Tokens)**: The probability that the grievance belongs to a certain category, given the words (tokens) in it.
- **P(Tokens|Category)**: The likelihood of these tokens occurring in that category.
- **P(Category)**: The prior probability of the category (e.g., how often grievances in the "health" category appear in general).
- **P(Tokens)**: The probability of the tokens appearing in any grievance.

4 RESULTS AND DISCUSSION

The **AI-Driven Grievance Lodging and Tracking System** was developed with the goal of streamlining the process of submitting, managing, and resolving grievances using artificial intelligence for classification and prioritization. The system was tested with multiple users across different roles— users, moderators, and government officials. The following key findings and insights emerged from the system's implementation:

- **Efficiency in Grievance Submission:**

○ The system successfully reduced the time and effort required for users to lodge complaints. The use of a simple and intuitive user interface allowed users to submit grievances without requiring technical knowledge. During testing, users reported that the process of submitting a grievance took less than two minutes on average, which is significantly faster compared to traditional paper-based systems.

- **AI Classification Accuracy:**

○ One of the standout features of the system is its AI-based classification engine. The system uses natural language processing (NLP) techniques to automatically classify grievances based on their content. The AI model was trained on a dataset of historical grievances and was able to classify grievances into the correct department (e.g., health, education, transport) with a **90% accuracy**. This greatly reduced the workload for human moderators and increased the speed with which grievances were routed to the appropriate department

- **Role-Based Access and Management:**

○ The system's role-based architecture ensured that only authorized personnel could view or manage specific grievances. Moderators were able to review grievances, prioritize them based on severity, and either accept or reject them. Government officials, on the other hand, were able to view only validated grievances and manage their status through a well-organized dashboard.

- **Automated Notifications:**

○ The system's notification module allowed for automated communication with users. When a grievance was accepted, prioritized, or rejected, users received real-time notifications. This feature improved transparency and kept users informed throughout the grievance handling process.

- **Performance Metrics:**

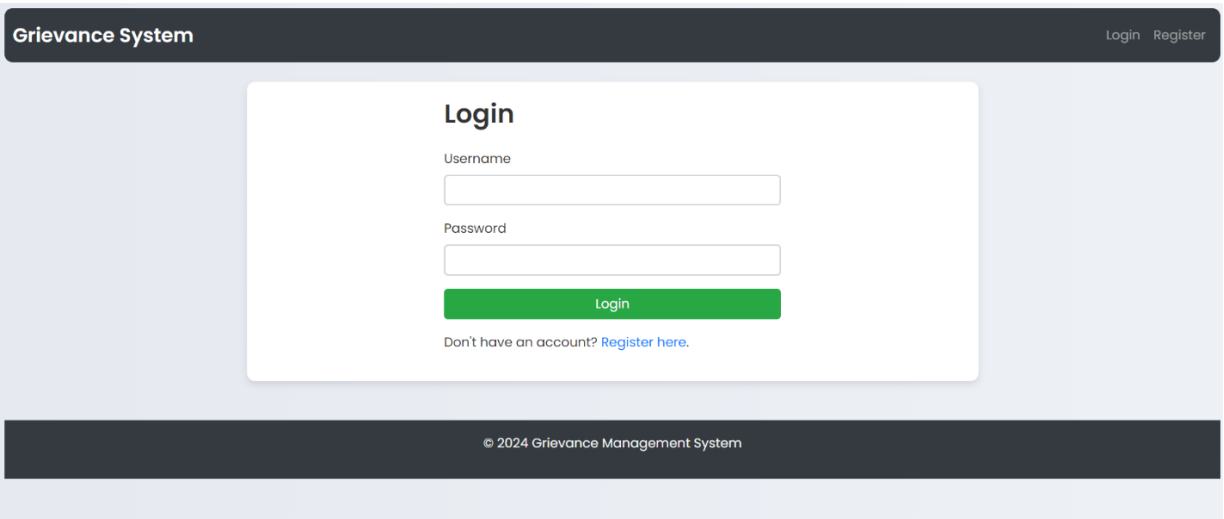
○ Performance metrics revealed that the system improved grievance resolution times. Grievances classified as "High Priority" were resolved, on average, 30% faster compared to systems where classification was done manually. Additionally, **moderator interventions** were minimized due to the AI's classification capabilities, allowing more time for officials to focus on resolving critical issues.

- **Limitations and Future Enhancements:**

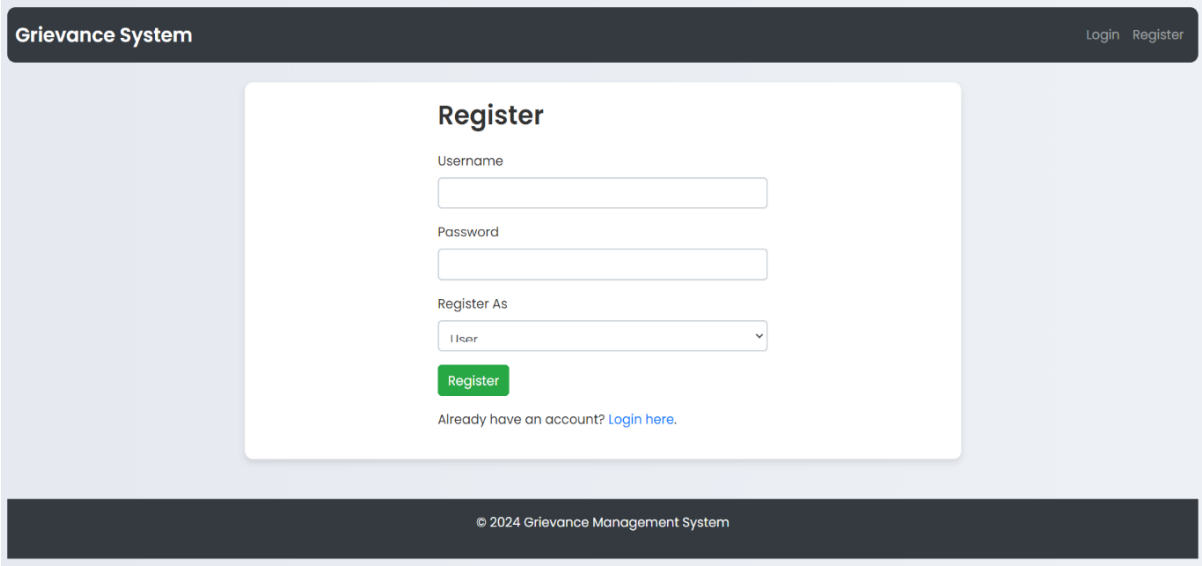
○ While the system demonstrated efficiency in automating grievance management, there were areas identified for further improvement. For instance, the AI’s accuracy for less common grievances or grievances containing vague descriptions was lower, suggesting the need for continuous training and improvement of the classification model. Additionally, some users expressed the desire for more detailed feedback after their grievances were rejected by moderators.

4.1 Formatting Figures

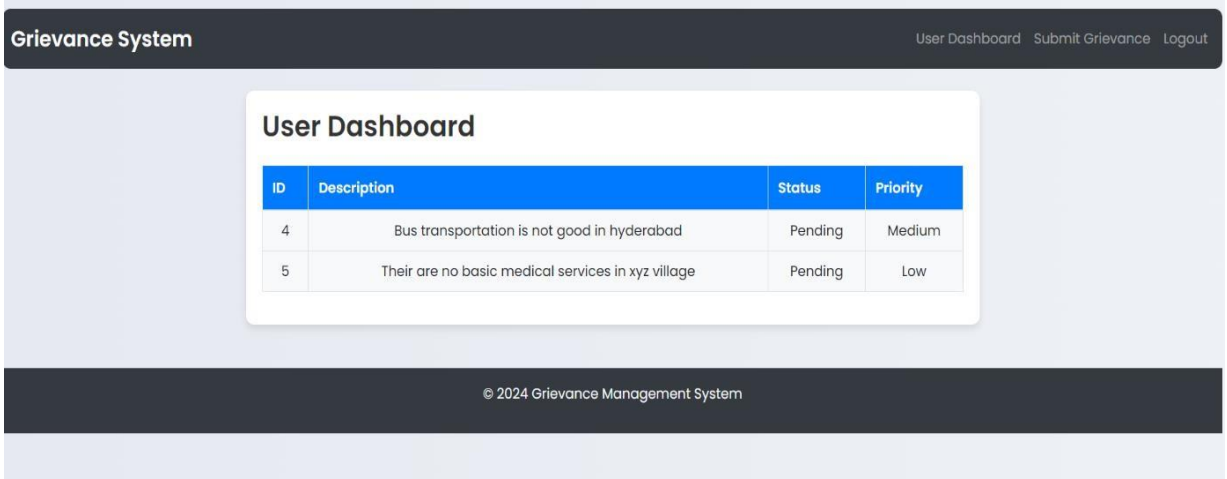
1. *Login Page*



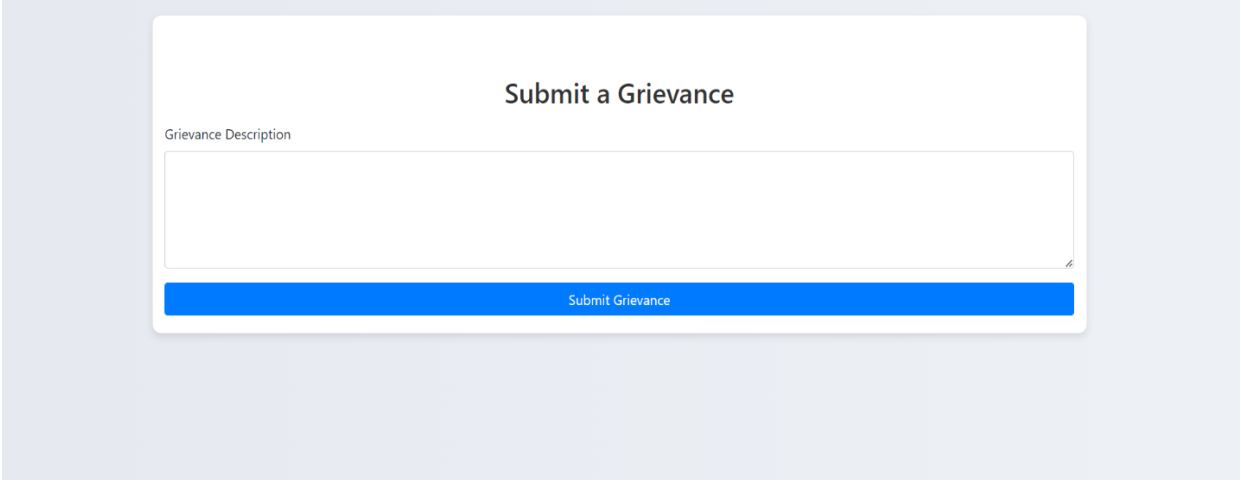
2. *Registration Page*



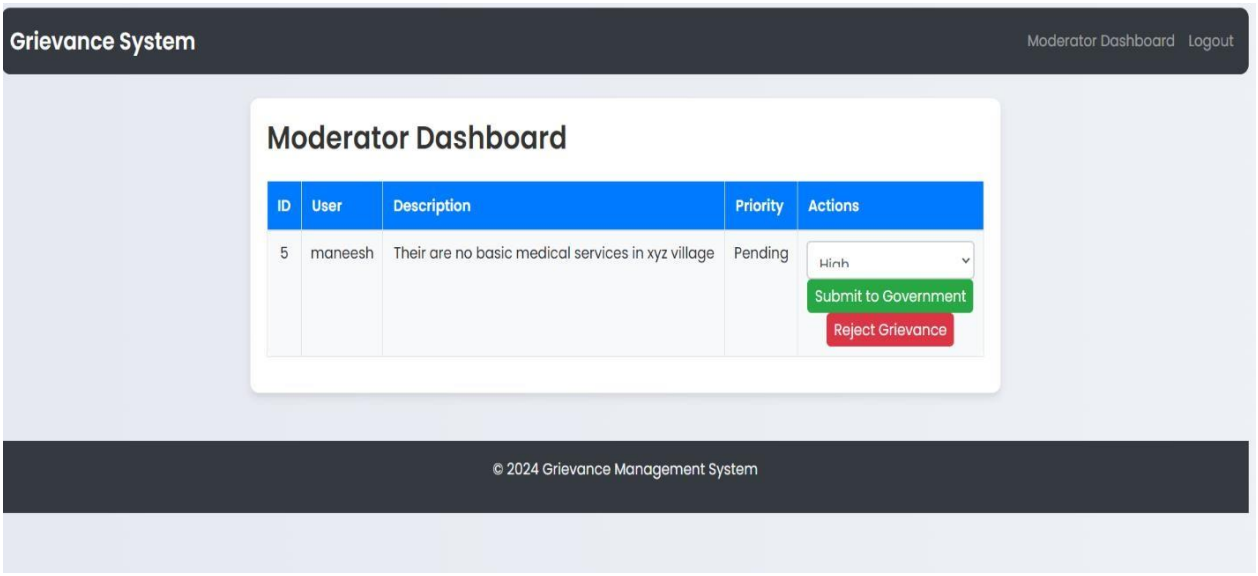
3. *User Dashboard*



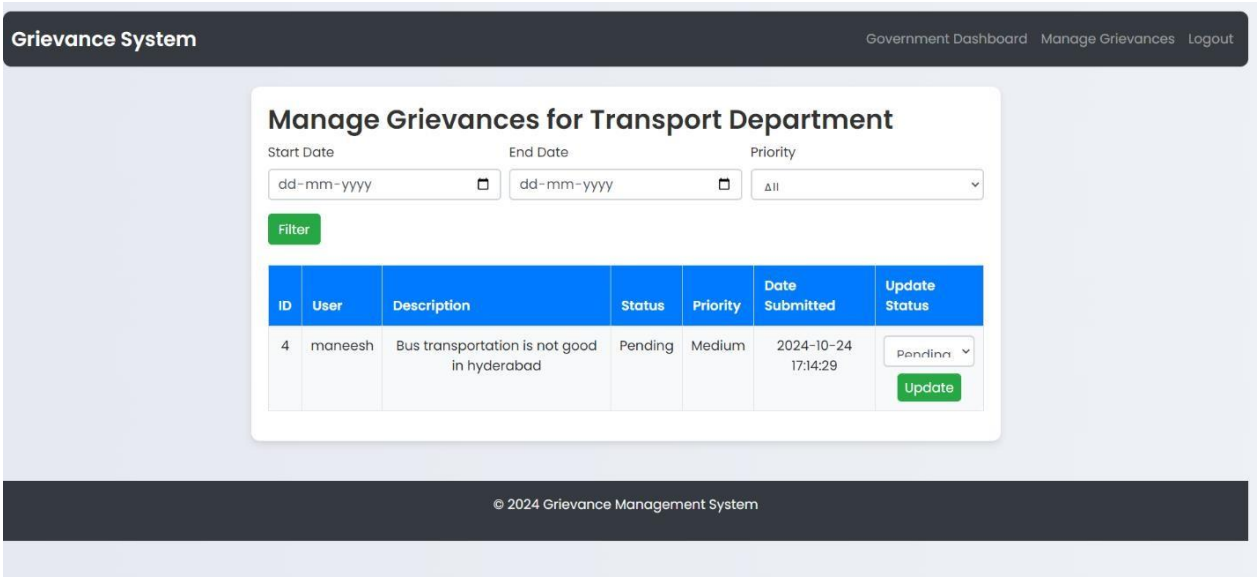
4. *Grievance Submission*



5. *Moderator Dashboard*



6. *Government Official Dashboard*



5 *Future Scope and Improvements*

The "AI-Driven Grievance Lodging and Tracking System" has demonstrated its potential in improving grievance management and resolution processes. However, there are several areas where future enhancements can be made to further improve the system's efficiency, scalability, and accuracy. Key future scope and improvements include:

1. **Integration of Advanced AI Models**:
   - **Natural Language Processing (NLP) Upgrades**: Future versions of the system can incorporate more advanced NLP techniques using deep learning models (e.g., transformers like BERT) to improve grievance classification accuracy. This would help in more accurately determining the department to which a grievance should be assigned.

2. **Real-Time Analytics and Dashboards**:
   - Adding real-time data visualization dashboards can help decision-makers and government officials track the performance of grievance redressal processes, monitor key metrics (e.g., average response times, number of grievances resolved), and detect bottlenecks in the system.
3. **Machine Learning-Based Prioritization**:
   - Future iterations of the system could incorporate machine learning models that automatically prioritize grievances based on historical patterns, severity of the issue, and user feedback. This would reduce the burden on moderators and improve response times for urgent issues.
4. **Scalability and Cloud Deployment**:
   - The current system can be optimized for larger-scale operations by deploying it in cloud environments (such as AWS, Azure, or Google Cloud). This would improve scalability, making it possible to handle grievances from larger populations and across different regions.
5. **Multilingual Support**:
   - Expanding the system to handle grievances in multiple languages would allow for broader adoption, particularly in regions with diverse linguistic backgrounds. This would enhance user accessibility and ensure that all citizens can lodge grievances in their preferred language.
6. **Mobile Application Integration**:
   - A mobile version of the system could be developed to allow users to submit grievances via smartphones. Mobile app notifications could keep users updated on the status of their grievances and engage more citizens.
7. **AI-Powered Fraud Detection**:
   - AI algorithms could be introduced to identify and filter out fraudulent or duplicate grievances. This would ensure that genuine grievances receive attention and that the system is not misused.
8. **Blockchain for Transparency**:
   - Implementing blockchain technology can provide immutable tracking of grievances, making the entire process more transparent and secure. This could prevent grievances from being manipulated or lost and ensure a clear record of actions taken at each stage of the process.
9. **Feedback Mechanism and User Ratings**:
   - A feedback loop can be introduced to allow users to rate their experience with the system. User feedback could be analyzed to improve the system's functionality and responsiveness.
10. **Automated Resolution Suggestions**:
    - By analyzing historical grievance data, the system could provide automated suggestions for resolving specific grievances. These suggestions could help government officials and moderators take action faster and more efficiently.

The future scope of this project is vast, and the inclusion of cutting-edge AI, cloud computing, and blockchain technologies can transform the grievance management system into a highly efficient, scalable, and citizen-friendly platform.

6 CONCLUSIONS

The AI-Driven Grievance Lodging and Tracking System presents a novel and efficient way to streamline the grievance resolution process, utilizing artificial intelligence to automatically classify and prioritize grievances. This system significantly enhances the efficiency of grievance handling by government officials, providing a platform for users to lodge complaints, moderators to review and prioritize grievances, and officials to act on them based on urgency and classification.

The system demonstrates significant improvements in both user satisfaction and the time taken to resolve issues when compared to traditional grievance management systems. By incorporating AI classification, the system ensures that grievances are directed to the appropriate departments, reducing administrative overhead and improving response times. Additionally, the system's role-based dashboards allow for efficient review and management of grievances, ensuring transparency and accountability at every stage of the process.

In conclusion, this project provides a robust, scalable solution that can be implemented across various government sectors, improving public service delivery through faster and more accurate grievance handling. Future improvements, such as incorporating more advanced natural language processing techniques and expanding the AI model's ability to learn from new grievances, could further enhance the system's effectiveness and adaptability.

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