

An AI-driven smart grievance analysis and escalation system for educational institutions

Kiruthiga K^{1*}, Gobika R², Kavyashree V²

¹Assistant Professor, Computer Science Engineering Specialized in Artificial Intelligence and Machine Learning, *KPR Institute of Engineering and Technology* Coimbatore, India

²UG student Computer Science Engineering Specialized in Artificial Intelligence and Machine Learning, *KPR Institute of Engineering and Technology* Coimbatore, India

Abstract. Resolving complaints in educational institutions is most of the time a slow, cumbersome operation and hence, the students are disappointed many times. Old, style methods rely on pre, determined formats and manual routing which further extend the time for problem-solving, apart from giving very limited transparency. This study presents a SMART Grievance Analysis and Escalation System, which is an AI, based web platform through which the students can lodge their grievances by means of a conversational interface. It uses artificial intelligence to analyze the problems, understand the main idea of the text, detect the topic and level of urgency, and automatically decide the staff members to whom the complaints should be referred. The portal, created with React, Firebase, and Gemini AI API, features live changes, role, based dashboards, sentiment, aware prioritization, and feedback, driven resolution loop. The system introduced can make the grievance reparation process more efficient, open, and user, friendly.

1 Introduction

Educational Institutions deal with many complaints concerning Academics, Infrastructure, Administrations and Student Welfare. To ensure the values of Trust, Transparency and Accountability are maintained; it is important for Educational Institutions to have an adequate Grievance Management System for each area specified. In larger Institutions, there might be anywhere from hundreds to thousands of Grievances generated daily. This considerable volume of Grievances makes a manual process of managing them extremely inefficient and considerably "Error Prone". These delays in resolving Grievances may lead to further frustration from the Complainant which could subsequently result in the loss of trust from the Complainant and substantial damage to the Institution's Reputation.

Over the past few years, Artificial Intelligence (AI), Natural Language Processing (NLP) and Cloud Computing Technologies have greatly enhanced the opportunity for complete automation.

^{1*} Corresponding author: kiruthiga@kpriet.ac.in

1.1 Motivation

Growing complexities and volume of student grievances that could hardly be handled by traditional methods have been the main reasons for conducting this research. The employment of manual systems for the handling of student grievances has contributed to a situation in which there is a lack of urgency and emotional context in the execution of the complaints, thus the institution responds to these cases with delay. Moreover, students do not have enough information about the progress of their complaints. Such difficulties have led to the development of an automated and intelligent grievance management system that puts students first.

1.2 Problem Statement

Most of the existing grievance management systems are just different types of forms that have to be processed and managed by humans. The main problems with these systems are: the fact that complaints are manually classified, the delayed routing to the authorities that are responsible, the absence of prioritization based on the level of the urgency, and the lack of real, time tracking. Due to these constraints, there occur unanswered grievances, increased administrative workload, and decreased institutional efficiency.

1.3 Importance of Smart Grievances System

By facilitating a quicker response, enhanced openness, and uniform policies for the escalation of grievances an AI, powered grievance system is able to reform the governance of an institution at any level. Automating the process of grievance analysis lightens the load of the concerned authorities, eliminates the bias of the human processor, and also increases the level of the organization's accountability. These kinds of mechanisms hold extreme significance mainly in the case of big educational institutions where the factors of scalability, and reliability, are of utmost importance.

1.4 Research Objectives

The primary goals of this study are as follows:

- Creating an AI, powered complaint handling system with conversational interfaces as the point of interaction.
- Automatically performing complaint classification, assessment of the level of urgency, and escalation.
- Implementing the technology behind the cloud for the real, time tracking of grievances.
- Comparing the performance of AI, assisted grievance resolution with that of the traditional methods by means of a survey.

1.5 Contributions

This paper makes the following contributions:

- A grievance submission framework powered by conversational AI, enabling users to report issues in a more interactive and accessible manner.

- An automated classification and escalation mechanism that leverages NLP techniques to analyze and route complaints efficiently.
- A scalable cloud-based architecture designed to support real-time monitoring and tracking of grievances.
- A practical, application-focused implementation tailored specifically for deployment within educational institutions.

1.6 Paper Organization

This paper is organized as follows:

- **Section II** provides an in, depth review of the research works that conducted in the field.
- **Section III** details the methodology and technologies used.
- **Section IV** presents experimental results and outputs.
- **Section V** concludes with future research directions.

2 Literature review

Patel and Khanna [1] studied how web-based complaint management systems in colleges have provided significant advantages over traditional paper-based complaint management systems, but have also introduced challenges in automating complaints. In addition, they found that data-driven methods of handling complaints can be used to streamline the complaint handling process within colleges (Verma, Khursheed, Prasad) [2].

Sharma and Mehta [3] also performed a comparative study of the traditional ways of handling complaints and those using AI, and concluded that the use of AI to aid in the response time and accuracy in addressing complaints was substantial. Singh and Thomas [4] investigated how AI can assist in the resolution of educational grievances and highlighted how NLP can assist in understanding the sentiment of a grievance in order to appropriately allocate the grievance and provide appropriate resolution.

Banerjee, Chatterjee, and Roy [5] reviewed workflow automation in handling student grievances and underscored the importance of routing grievances to the appropriate party using an intelligent routing system. Nair and Kulkarni [6] conducted a comprehensive literature review of the challenges facing AI-assisted grievance systems including issues related to privacy and scalability, and identified various potential solutions for overcoming the challenges facing these systems.

Agarwal and colleagues [7] studied trends and challenges related to automated complaint redressal and noted that the greatest barrier to the adoption of automated complaint redressal systems is resistance to technology. Menon and Bhattacharya [8] looked at the effects of chatbots and NLP on the grievance process, and found that chatbot-enabled grievance processes produced increased user involvement and reduced time to submit a complaint.

Hussain et al. [9] discussed escalation methods in AI, powered complaint systems and pointed out the most significant ones as being the rule, based and priority, driven escalation strategies. Joseph and Abraham [10] stressed the significance of openness and responsibility as two main features in the functioning of digital grievance platforms. Smith

and Wang [11] went a step further in the direction of automated complaint analysis by researching Natural Language Processing techniques to extract useful insights from user complaints. Kumar and Singh [12], on the other hand, employed sentiment analysis to prioritize users' issues and illustrated that emotional context can be used as a tool in decision-making processes of complaint handling systems.

In their study, Lee and Park [13] also focused on chatbotbased service systems with deep learning as the underlying technique, and pointed out that such systems are not only helpful in improving user interaction but also in raising their engagement levels. On the other hand, Brown et al. [14] came up with scalable cloud-based information systems for school environments, and the primary message of the paper is the significance of reliability and real-time data availability. Zhou and Chen [15], through their paper, described the utilization of AI techniques to automate the workflow and illustrated how intelligent systems can be used to facilitate task allocation and process management.

However, as a matter of fact, these ambitious research efforts have not yet resulted in the development of a complete framework integrating real, time AI, driven grievance analysis and escalation, which constitutes the main thrust of this paper.

3 Methodology

Smart Grievance System is an innovative modular cloud delivery web application supporting live user interaction, smart analysis of complaints, auto, escalation, and visualization for a continuous monitoring experience. The idea is to break down the system into distinct functional components, each capable not only of handling a particular phase of the grievance cycle remotely but also performing the work independently. The software serves as a public online platform that is accessible to all and that can be reached via Netlify. Thus, it is very accessible, and can handle lots of users at the same time.

3.1 System Architecture

The core system is structurally built around the concept of three layers such as:

- **Presentation Layer:** The frontend developed using React and TypeScript and hosted on Netlify, thus students and staff can have a responsive user experience.
- **Backend and Cloud Services Layer:** For securely storing the data from the users and providing live synchronization of data, Firebase Authentication and Firestore database have been chosen as the cloud service provider. Through these services, user access control is also managed.
- **AI Intelligence Layer:** The Google Gemini API is used for natural language understanding, complaint analysis, and chatbot interaction. This layered architecture is a step towards scalability of model, maintainability of the system, and separation of concerns for missed complaints.

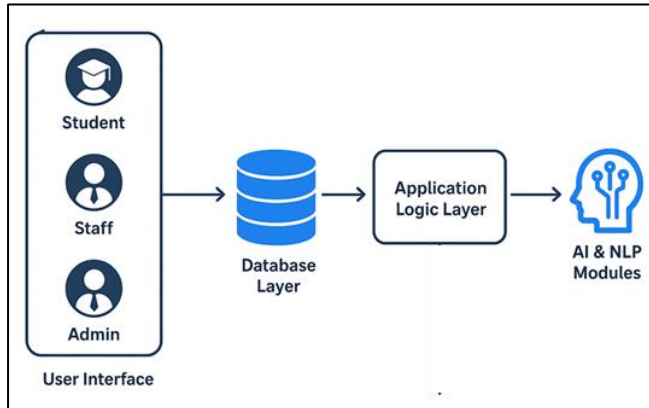


Fig. 1. System Architecture

3.2 User Management Module

User management is handled through Firebase Authentication along with Firestore, based user profiles. The platform accommodates different roles such as Student, Staff, Coordinator, Head of Department (HOD), and Admin. Role, based access control is in place to guarantee that users have access only to the features that are relevant to their duties. The authentication state is stored with the help of React Context, which allows safe session handling throughout the app.

3.3 Grievance Submission and Chatbot Module

With the help of an AI chatbot, students can write their complaints to the university in a more understandable manner and thus, they do not have to fill in a static form. The chatbot dynamically poses additional questions to help it understand the situation better and also to gather the information that is probably missing, for instance, the place, department, or time of the occurrence of the grievance. By offering a conversational way of communication, this new method is more user, friendly and, therefore, contributes to lowering the number of incomplete submissions. Hence, they can be utilized as supporting material for the verification of the submitted complaints.

3.4 AI-Based Grievance Analysis

Once data collection is over, Gemini AI goes through the entire information which it had extracted from the conversation and thus it creates a detailed analysis. The analysis depicts the feature(s) of the complaint which is fundamental, classifying the complaint into fixed concern areas (academic; infrastructure; hostel etc), deciding the level of urgency (low, moderate, high, critical), checking the sentiments by the use of natural language processing tools and generating a brief description of the complaint.

Through this automatic analysis method, organizations will reduce the dependency on their employees and as a result, they will be able to attain more uniformity in their grievance handling process throughout the organisation.

3.5 AI Processing

The Gemini AI model, through its meticulously designed prompts, was tasked to derive three major complaint features from each complaint: category, urgency level, and emotion. The prompts contained rich and dense contextual information along with reference to various departments of the institution, escalation policies, and sample grievance case examples. Emotion analysis was carried out by assigning a polarity system of negative, neutral, and positive sentiments. Urgency level was derived based on the density of specific keywords, overall sentiment polarity, and presence of contextual clues such as safety concerns or a pending academic deadline. For reliability and consistency of outputs, the outputs that were created by Gemini were cross-checked using rule-based validation methods. This method greatly assisted in confirming the correctness of department assignment and escalation level.

3.6 Automated Assignment and Escalation Logic

Based on the identified department and urgency level, the system, which is an intelligent one, automatically distributes the grievances to appropriate officials. For instance, complaints with low and medium levels of urgency are delivered to staff members, while those with high and critical levels are forwarded to coordinators or HODs. If the authority to which the device has been assigned is in a bad condition or the complaint has not yet been resolved, the system offers the option of changing the assignment and escalating the issue to the higher level hierarchy, thus allowing the problem to be returned quickly.

3.7 Complaint Tracking and Workload Management

Firestore, real-time listeners provide the capability to indefinite observation of changes in the status of a complaint.

In this way, pupils are able to follow the advancement of their grievances right from the time of submission to the moment when they are solved.

The personnel and management members are provided with the help of the role-based dashboards with the information of the location of the grievances that have been assigned to them, the degrees of urgency, the statistics of the workload, and the actions that are not yet taken. This module gives the administration a lesser load and shows them the situation more clearly which is a great improvement in the management of operations.

3.8 Feedback and Satisfaction Module

Once a complaint has been settled, students have the opportunity to express their opinion through stars and written comments. If the user is not satisfied, the system offers the option of re-filing or reassignment as well. Feedback information is combined and presented in management panels. Thus, schools can analyze the quality of services, the performance of the personnel, and the most frequent causes of complaints.

3.9 Deployment and Accessibility

Since the front end is put on Netlify, it enables continuous integration and quick changes. Since the backend is supported by Firebase cloud services, a traditional server setup is not required. Such a deployment configuration combination guarantees that the grievance management system will be able to scale up, be stable, and easily maintained.

4 System Design and Implementation

4.1 Dataset

Instead of relying on a previously collected, fixed dataset, the system generates its dataset through real people interacting with it. The dataset is the central store of all student complaints and includes: complaint narratives, chat records, complaint classifications/types, urgency levels, sentiment scores, timestamps of incidents, and users' feedback on the response.

4.2 Overall Architecture

The system implements a three, layered architecture: a React and TypeScript user interface hosted on Netlify; The server part with Firebase Authentication for securely logging in and Firestore for storing and synchronizing the data in real time; The intelligence part is powered by the Google Gemini API for performing tasks such as complaint classification, urgency detection, sentiment analysis, and response generation. Such a layered design enables modularity and scalability.

4.3 Technologies Used

- **Backend:**
 - Firebase Authentication to allow users to securely login and to implement role, based access control;
 - Firebase Firestore to perform real, time database operations and keep data synchronized;
 - Google Gemini API to analyze grievances with AI and also for chatbot interaction.

- **Frontend:**
 - React with TypeScript to create highly interactive user interfaces
 - Tailwind CSS for a flexible and harmonious UI design experience
 - Vite as the build tool for both faster development and production builds
 - Netlify for frontend deployment as well as continuous integration

4.4 Data Ethics & Security

Grievance information collected from the system is anonymized by removing any personally identifiable details before storing it. At the time of registering, user permission is obtained, and access to data is managed via role, based authentication methods. The platform complies with secure cloud storage standards by applying Firebase security rules together with encrypted communication protocols to safeguard data from both storage and transmission. Ethically, the system is capable of stopping the abuse of delicate complaint information, and can support the justice of automatic decision making by offering the administrators the facility to change decisions manually if needed.

4.5 Steps to Run the System

- Through the URL hosted on Netlify, users visit the deployed application.
- Using Firebase Authentication, students and staff sign up and sign in.

- Students use the chatbot interface to raise their complaints.
- The AI system processes the complaint, identifies the type, urgency, and mood.
- Therefore, the system, depending on the level of urgency, either allocates the grievance to a staff member or escalates it automatically.
- Through role - based dashboards, the staff members update the status of the grievances.
- Students monitor the status of their grievances instantly and give their feedback after the matter has been settled.

4.6 Evaluation Metrics

The performance of the proposed system was evaluated using the following metrics:

- Classification Accuracy = Correctly classified grievances / Total grievances
- Average Response Time Reduction (%)
- User Satisfaction Score (measured through post-resolution feedback)
- Escalation Efficiency (percentage of grievances resolved at correct authority level)

4.7 Limitations & Bias Risks

If historical grievance patterns truly mirror institutional inequalities, then the system may unintentionally inherit those biases. Besides, unclear or badly written complaints might even lower the level of classification accuracy. In order to overcome this problem, various manual review options, feedback loops, and regular audits of the AI decisions are incorporated into the system.

4.8 Integration Challenges

Bringing the solution together with existing ERP systems of institutions quite frequently brings about problems such as: matching data structures, harmonizing authentication methods and ensuring a smooth workflow between systems. Proper data mapping is essential for accurate and reliable data transfer. We plan to focus on API, driven interoperability in our implementation whenever possible. With this approach, different systems will not only be able to share data without hiccups but will also make the most of real, time data and will rely less on human input. If standardized APIs are adopted, an integration will be less complex to run, more versatile, and easier to scale.

5 Results and Discussion

The new smart grievance system was evaluated based on a number of qualitative and functional criteria including the time taken for filing a complaint, accuracy in classifying grievances, effectiveness of the escalation mechanism, and user satisfaction. To make the observations, the system workflow was compared with the traditional, form, based grievance mechanisms.

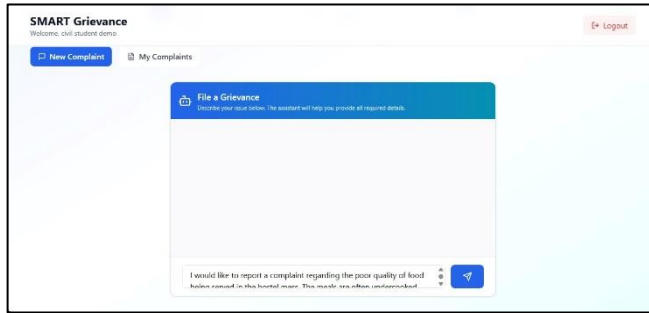


Fig. 2. ChatBot Interface

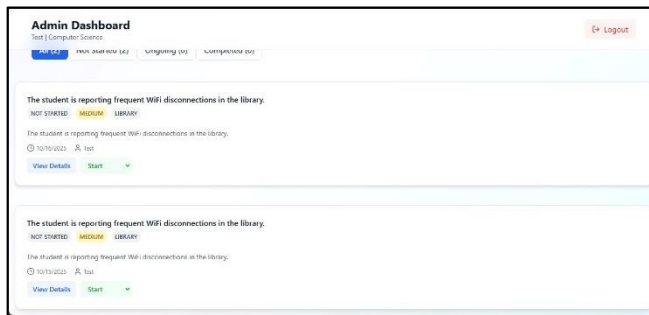


Fig. 3. Complaint Classification

Thanks to the conversational chatbot interface, the grievance filing time was significantly reduced as students were guided interactively instead of filling up lengthy forms. Classification based on AI led to more accurate assignments since it was able not only to identify the category of the grievance but also the urgency correctly.

Fig 3 Complaint Classification

Sentiment, aware prioritization made sure that emotionally critical and urgent grievances were the first ones to be addressed. Transparency was improved by real, time updates made possible through Firestore, thus students were able to track the progress of their grievances without making repeated follow, ups. The system helped to reduce the administrative work of the staff by cutting down on the routine work, mainly through automatic assignments and the use of well-designed and simple, to, understand dashboards.

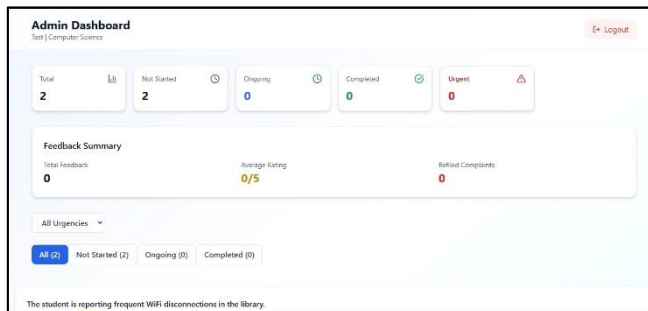


Fig. 4. Role-based administrative dashboard

In general, the findings suggest that the introduction of AI into the grievance management system boosts office efficiency, facilitates faster response, and raises the level of responsibility in the complaint handling process.

6 Conclusion and future work

The article was about an intelligent grievance analysis and escalation system driven by AI that is specially designed for the educational sector. Leveraging conversational AI, automated analysis, and cloud, based real, time updates, this system is able to address issues that usually take a long time in conventional grievance methods. Future expansions include the addition of languages, predicting trends in grievances, and the integration of educational institutions' ERP systems.

Through a mix of conversational techniques, auto categorization, and smart escalation methods, the idea of the AI grievance system is shown on a single platform. As a matter of fact, the suggested solution not only improves response time drastically but also increases the transparency of the process and manages the workload distribution effectively. On the other hand, there are still some issues with the system.

Firstly, it will work best if the user provides clear and complete text. Secondly, there is a possibility of human bias sneaking into the system while carrying out automated tasks. Besides enhanced multilingual support, ERP integration, increased use of predictive analytics, and supporting broad institutional scaling are a few of the areas that can be developed in the future.

References

1. R. Patel and S. Khanna, "Web-Based Complaint Management Systems in Academic Institutions," *Int. J. Educ. Software & Technology*, vol. 18, no. 2, pp. 112-121, 2025.
2. A. Verma, M. Iqbal, and P. Rao, "Data-Driven Approaches for Efficient Complaint Handling in Education," *J. Data Analytics & Institutional Research*, vol. 11, no. 4, pp. 67-79, 2025.
3. K. Sharma and D. Mehta, "Comparative Analysis of Traditional vs. AI-Integrated Complaint Management Systems," *Proc. ICAE, Dubai, UAE*, pp. 201-210, 2025.
4. R. Singh and A. Thomas, "Role of Artificial Intelligence in Educational Grievance Resolution," *J. Smart Education & Digital Transformation*, vol. 9, no. 1, pp. 34-48, 2024.
5. S. Banerjee, L. Roy, and P. Das, "Workflow Automation for Student Grievances," *Int. J. Academic Process Automation*, vol. 6, no. 3, pp. 55-66, 2024.
6. V. Nair and S. Kulkarni, "AI-Powered Grievance Management Systems: A Literature Review," *J. AI in Education Systems*, vol. 14, no. 2, pp. 88-97, 2023.
7. T. Agarwal, N. Chopra, and R. Desai, "Automation in Student Complaint Redressal," *Int. J. Student Welfare & Support Services*, vol. 7, no. 4, pp. 120-132, 2023.
8. S. Menon and P. Bhattacharya, "Impact of Chatbots and NLP on Grievance Redressal," *J. Machine Learning Applications*, vol. 22, no. 1, pp. 14-28, 2023.
9. A. Hussain, J. Kaur, and R. Fernandes, "Escalation Mechanisms in AI-Based Grievance Redressal," *Proc. Int. Conf. Smart Governance & Automation, Singapore*, pp. 76-85, 2023.
10. M. Joseph and D. Abraham, "Transparency and Accountability in Digital Grievance Systems," *J. Digital Governance & Ethics*, vol. 5, no. 2, pp. 41-52, 2023.
11. J. Smith and L. Wang, "Natural Language Processing Techniques for Automated Complaint Analysis," *IEEE Access*, vol. 9, pp. 112345-112356, 2021.
12. A. Kumar and P. Singh, "Sentiment Analysis for Prioritization of User Complaints," *IEEE Trans. Comput. Social Systems*, vol. 8, no. 3, pp. 678-689, 2021.
13. S. Lee and M. Park, "Chatbot-Based Service Systems Using Deep Learning," *IEEE Internet of Things Journal*, vol. 7, no. 4, pp. 3121-3130, 2020.
14. R. Brown et al., "Scalable Cloud-Based Information Systems for Education," *IEEE Cloud Computing*, vol. 6, no. 2, pp. 45-54, 2019.
15. K. Zhou and Y. Chen, "Workflow Automation Using AI Techniques," *IEEE Trans. Automation Science and Engineering*, vol. 17, no. 2, pp. 1023-1034, 2020.