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Complaint Management System with AI Ticket Routing

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ABSTRACT

Traditional complaint management systems in colleges and universities often lack transparency, structured routing, and clear escalation mechanisms, resulting in delayed resolution and reduced student satisfaction. ACE Complaint Management addresses these challenges through an AI-driven, web-based complaint management system designed to streamline grievance submission, routing, and resolution within a hierarchical institutional environment. The system integrates artificial intelligence at multiple stages of the workflow, where a classification module automatically categorizes complaints into departments such as Academic, Hostel, Infrastructure, Administration, Library, and Sports while assigning priority levels (low, medium, high, urgent). Sentiment analysis evaluates the emotional tone of submissions and flags critical or highly negative cases for immediate attention, and duplicate detection identifies similar complaints to enable batch handling and minimize redundancy. An AI chatbot assists users in complaint submission, tracking, and process-related queries. ACE Complaint Management implements a three-tier handling hierarchy in which Tutors perform initial triage and resolve simple issues, Heads of Department manage escalated or complex cases, and Principals decide on unresolved matters, with each level capable of resolving, forwarding, or requesting additional information. Students can monitor complaint status and access a timeline of actions and updates, while the system supports multiple user roles including Students, Tutors, Heads of Department, Principals, Department Administrators, and Super Administrators through role-specific dashboards and permissions. The application is developed using React, TypeScript, and Vite for the frontend, Supabase for backend services and authentication, and Edge Functions for AI processing, with the interface built using Tailwind CSS and shadcn/ui components supporting dark/light themes and multilingual accessibility. Overall, ACE Complaint Management combines AI-powered routing, sentiment analysis, duplicate detection, and hierarchical workflow management to enhance speed, transparency, and effectiveness in grievance resolution, improving student experience and institutional accountability.

Keywords: AI-Driven Complaint Management- Web-Based Grievance System- Complaint Classification- Sentiment Analysis- Duplicate Detection- AI Chatbot Assistance- Hierarchical Escalation Workflow- Role-Based Dashboards- Student Complaint Tracking- Institutional Transparency- React TypeScript Development- Supabase Backend Integration- Smart Campus Governance.

1. INTRODUCTION

Effective communication between students and institutional authorities is essential for maintaining

transparency and accountability in educational environments. Traditional complaint management systems in many colleges are often manual or poorly structured, lacking proper tracking, routing, and escalation mechanisms. This results in delayed resolutions, information loss, and reduced student satisfaction.

With the advancement of web technologies and artificial intelligence, grievance handling can be improved through digital platforms that automate categorization, prioritization, and monitoring of complaints. AI-based techniques such as classification, sentiment analysis, and duplicate detection can enhance efficiency and reduce administrative workload.

ACE Complaint Management is an AI-powered web-based complaint management system developed to streamline grievance submission, tracking, and resolution within a hierarchical framework. The platform enables students to submit and monitor complaints transparently while automatically categorizing issues, assigning priority levels, and supporting escalation through Tutors, Heads of Department, and Principals. Role-based dashboards and chatbot assistance further enhance usability and accessibility.

By integrating intelligent automation with structured workflow management, ACE Complaint Management aims to improve resolution speed, increase student satisfaction, and promote transparent governance in educational institutions.

2. LITERATURE SURVEY

The rapid growth of digital technologies in educational institutions has encouraged researchers to explore automated solutions for managing administrative processes and improving communication between students and institutional authorities. Traditional grievance handling systems in colleges are often manual and paper-based, leading to delays in complaint resolution, lack of transparency, and inefficient tracking mechanisms. To address these issues, researchers have proposed web-based complaint management platforms that allow users to submit grievances online while enabling administrators to monitor and resolve issues efficiently. These systems aim to enhance transparency, accountability, and institutional productivity through secure digital workflows.

Singh et al. [1] developed an AI-based grievance management system designed to automate complaint classification and routing within institutional environments. Their platform analyzes complaint text using machine learning techniques and directs it to the relevant department automatically. The system reduces administrative workload while ensuring faster response times and improved issue resolution.

Sharma and Gupta [2] proposed a web-based complaint management framework that enables users to submit grievances through an online portal and track their resolution status. Their system integrates notification services and centralized databases to improve transparency and maintain detailed records of complaint activities. The platform demonstrates how web technologies can simplify grievance management processes.

Das and Chatterjee [3] focused on applying sentiment analysis techniques for complaint classification using natural language processing. Their research highlights how analyzing the emotional tone of user complaints can help identify urgent or critical cases. The system prioritizes highly negative complaints, ensuring they receive immediate administrative attention.

Kulkarni and Joshi [4] introduced a role-based access control architecture for secure web applications. Their framework ensures that different stakeholders—such as students, faculty members, and

administrators—can access system functionalities according to predefined roles. This approach improves data security and maintains controlled access to sensitive institutional information.

Wang et al. [5] investigated duplicate detection methods for text-based complaint systems. Their study demonstrates how similarity algorithms can identify repeated complaints with related content, allowing administrators to group similar issues and address them collectively. This method reduces redundancy and improves system efficiency.

Brown and Anderson [6] explored modern web application development using React and cloud-based backend services. Their research highlights the benefits of modular frontend frameworks, responsive user interfaces, and scalable cloud infrastructures for building institutional management platforms that support real-time interactions and efficient data handling.

Reddy and Narayanan [7] presented an AI-powered chatbot system for automated user support, enabling users to submit complaints, receive guidance, and track resolution status through conversational interfaces. The integration of chatbots reduces administrative workload and enhances communication efficiency between users and institutional staff.

Verma and Mehta [8] developed a cloud-based complaint data management platform that integrates secure authentication, distributed storage, and real-time synchronization. Their system allows administrators to monitor complaints from multiple locations while ensuring data reliability and high system availability.

Gupta and Shah [9] proposed an online grievance redressal portal designed for educational institutions. The system includes complaint registration, document attachments, automated notifications, and administrative dashboards for monitoring issue resolution. Their platform demonstrates how centralized digital systems can improve communication between students and institutional authorities.

Nair et al. [10] introduced an AI-driven complaint routing mechanism that predicts the appropriate department for handling specific grievances. Their system uses machine learning models to analyze complaint content and automatically assign it to relevant administrative units, reducing processing delays and improving operational efficiency.

In addition to these implementations, recent research highlights the integration of cloud computing technologies in complaint management systems. Cloud-based infrastructures enable centralized storage of complaint records and allow administrators to access information securely from multiple locations, making these platforms scalable and accessible for institutions with distributed campuses [11]. Mobile-friendly interfaces and responsive web applications have also been developed to improve accessibility, enabling users to submit and track complaints through smartphones and tablets [12].

Furthermore, Artificial Intelligence (AI) and Machine Learning (ML) techniques are increasingly being incorporated into grievance management platforms. Intelligent algorithms can analyze large volumes of complaint data, identify patterns, and predict recurring institutional issues, helping administrators make proactive decisions and reduce manual workload [13]. Similarly, data analytics dashboards provide administrators with real-time insights into complaint trends, departmental performance, and resolution timelines, enabling more effective institutional planning and management [14].

Modern systems also incorporate automated notification mechanisms, including email alerts, SMS updates, and real-time status notifications, ensuring users receive timely updates regarding complaint progress [15]. These communication features improve transparency and reduce the need for manual follow-ups.

Overall, recent studies emphasize the importance of web-based technologies, cloud storage, AI integration, responsive design, role-based access control, and analytics dashboards in improving the efficiency, transparency, and reliability of complaint management systems. However, many existing platforms focus on individual functionalities rather than providing fully integrated solutions. The integration of multiple intelligent modules—including complaint submission, automated classification, sentiment analysis, duplicate detection, and hierarchical escalation—represents a significant advancement toward building comprehensive grievance management platforms for educational institutions. Such systems enable institutions to handle large volumes of complaints efficiently while ensuring accountability, transparency, and improved user satisfaction.

3. METHODOLOGY

The methodology of the CampusResolve – AI-Based Complaint Management System is designed to provide a secure, intelligent, and efficient platform that automates and streamlines the grievance management process within educational institutions. The system follows a modular and user-centric approach, enabling students, tutors, department heads, and administrators to interact seamlessly through a unified digital environment. Each functional module—including Complaint Submission, Complaint Classification, Sentiment Analysis, Duplicate Detection, Department Routing, Escalation Mechanism, Notification System, and Administrative Dashboard—operates independently while remaining interconnected through a centralized backend, ensuring smooth data flow and real-time updates across the platform. This modular architecture enhances scalability, flexibility, and maintainability while enabling efficient workflow management throughout the grievance resolution lifecycle. The system is developed using React.js with TypeScript and Tailwind CSS for the frontend interface, providing a dynamic, responsive, and interactive user experience, while Supabase is used for backend services including authentication, database management, and real-time data synchronization. The database securely stores structured information such as user profiles, complaint details, complaint categories, department assignments, priority levels, and resolution history, ensuring reliable data access and integrity. Communication between system components is managed through API-based interactions that facilitate seamless data exchange between the frontend interface and backend services. The CampusResolve system follows a client–server architecture with cloud-based integration, enabling users to access the platform from multiple devices while maintaining high availability and scalability. Artificial Intelligence techniques are incorporated to enhance automation, where complaint classification algorithms categorize grievances into relevant departments and sentiment analysis evaluates the urgency of complaints to assign priority levels. Additionally, duplicate detection mechanisms analyze textual similarities to identify repeated complaints and reduce redundancy. A hierarchical escalation mechanism ensures that unresolved complaints are automatically forwarded to higher authorities within predefined timelines, improving accountability and transparency.

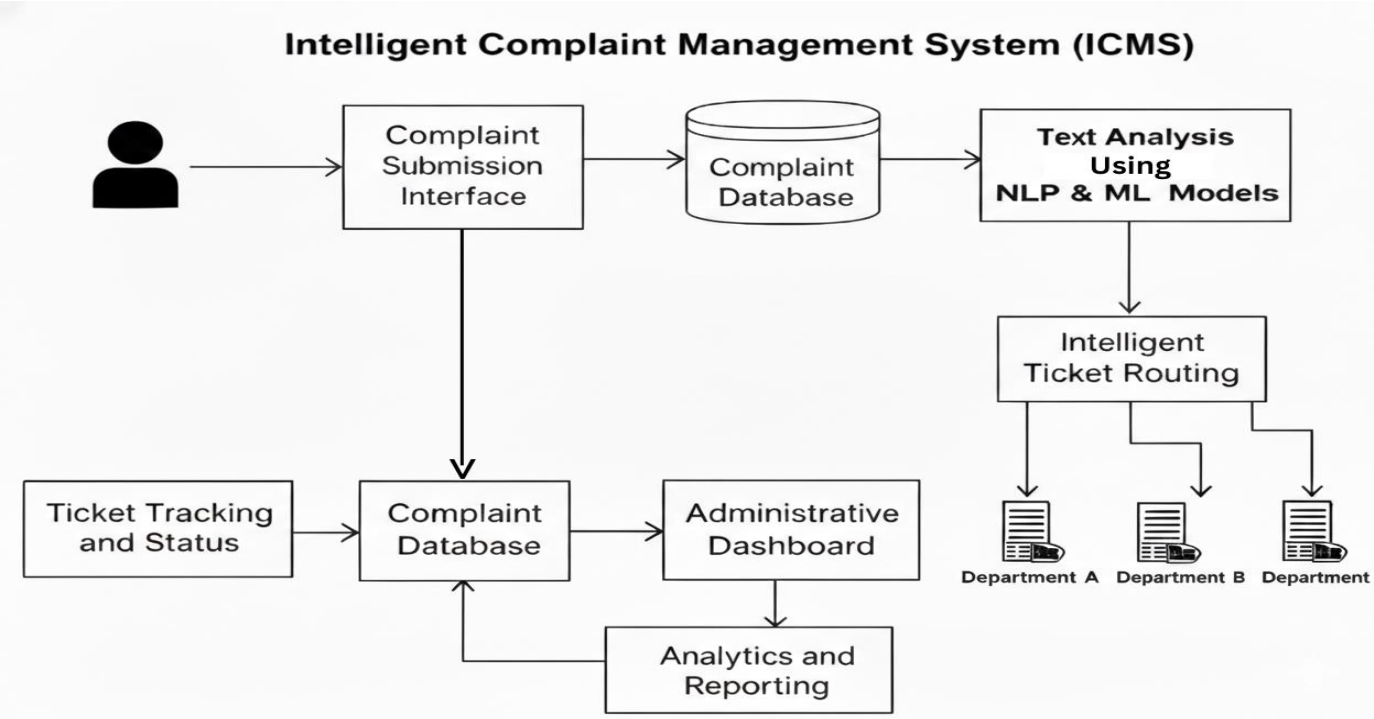

Figure 1: Architectural Design

1. Complaint Submission Module

This module serves as the primary interface through which students register and submit complaints digitally. It captures detailed information such as complaint category, description, supporting attachments, and preferred department selection. The interface includes validation mechanisms to ensure required fields are completed before submission. Once submitted, the complaint is recorded in the system and forwarded to the AI processing layer for classification and routing, minimizing manual intervention and ensuring structured data collection.

2. AI Processing & Routing Module

This module integrates artificial intelligence techniques to automate complaint handling. It performs classification to categorize complaints into relevant departments, assigns priority levels, analyzes sentiment to identify urgent or critical cases, and detects duplicate submissions to avoid redundancy. Based on the results, complaints are intelligently routed to appropriate authorities, improving accuracy, response time, and administrative efficiency.

3. Role-Based Dashboard Module

The dashboard module provides customized interfaces for different users including Students, Tutors, Heads of Department, Principals, and Administrators. Each dashboard displays relevant tasks, complaint lists, and status indicators. Authorized users can review, update, escalate, or resolve complaints depending on their role permissions. This module enhances system organization and ensures secure access control across institutional levels.

4. Escalation & Workflow Management Module

This module manages the hierarchical complaint resolution process. Complaints initially assigned to Tutors can be escalated to Heads of Department and further to Principals if unresolved. Each stage supports actions such as forwarding, resolving, or requesting additional information. The structured workflow ensures accountability, clear responsibility distribution, and systematic resolution tracking throughout the complaint lifecycle.

5. Chatbot Support Module

This module enables users to monitor complaint status through a timeline of actions and updates. Automated notifications inform users about progress or required actions. Additionally, an integrated chatbot assists users in submitting complaints, tracking updates, and answering system-related queries. This module improves accessibility, transparency, and user engagement within the platform.

6. Security Measures

Security is a critical component of the CampusResolve – AI-Based Complaint Management System to ensure the protection of user data and system integrity. The platform implements several security mechanisms, including:Encrypted storage of sensitive student information.

- Secure user authentication using Supabase authentication services to protect login sessions.
- Role-based access control to restrict system functionalities for students, tutors, department heads, and administrators.
- Encrypted storage of sensitive user information and complaint data within the database.
- Input validation and sanitization to prevent malicious attacks such as SQL injection and cross-site scripting (XSS).

These mechanisms ensure confidentiality, integrity, and availability of all user data while maintaining compliance with data protection standards.

7. Workflow and User Experience

The system provides a seamless end-to-end workflow for managing institutional complaints efficiently:

1. Student registers and logs in to the system using secure authentication.
2. Student submits a complaint by selecting the appropriate category and providing necessary details.
3. The system automatically classifies the complaint and assigns it to the relevant department.
4. Administrators or responsible authorities review the complaint and take appropriate action.
5. Students receive real-time notifications regarding complaint status updates and resolution progress.

The interface is designed with a responsive and user-friendly layout, ensuring smooth accessibility across desktops, tablets, and mobile devices. Clear navigation menus, validation messages, and interactive prompts guide users during complaint submission and tracking, providing a simple and efficient experience for both students and administrators.

9. Scalability and Future Enhancements

The CampusResolve – AI-Based Complaint Management System is designed with a modular and

scalable architecture, allowing the platform to accommodate future technological advancements and institutional requirements. The system can be extended with additional features such as:

- Advanced AI models for improved complaint classification and priority prediction.
- Predictive analytics to identify recurring institutional issues and complaint trends.
- Chatbot integration to assist users in submitting complaints and tracking their status.
- Mobile application support for enhanced accessibility and instant notifications.
- Multi-language support to serve users from diverse linguistic backgrounds.

The cloud-based infrastructure ensures high availability, reliable performance under increasing user loads, and seamless scalability, enabling the system to support multiple departments, campuses, or educational institutions in the future.

4. CONCLUSION

The ACE Complaint Management project successfully demonstrates how traditional grievance handling processes within educational institutions can be transformed through digital automation and intelligent routing mechanisms. Conventional complaint systems often suffer from lack of transparency, delayed responses, and unstructured escalation procedures. By introducing a centralized web-based platform, the system provides students with a convenient method to submit complaints, attach relevant details, and monitor progress without physical paperwork or repeated follow-ups.

From an administrative standpoint, the platform offers structured dashboards that enable staff members at various levels to review, categorize, and resolve complaints efficiently. The hierarchical escalation framework ensures that unresolved issues are forwarded appropriately, improving accountability and decision-making.

The integration of modern web technologies and AI-assisted processing highlights the significance of intelligent automation in institutional management. Automated classification, prioritization, and duplicate detection reduce manual workload and enhance operational accuracy. Secure authentication and role-based access controls maintain data privacy and integrity, ensuring that sensitive information is protected while enabling smooth collaboration between users and administrators.

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