AI-Powered Complaint and Smart Knowledge Base System

A Proposal Submitted to the department of Computer Science and Engineering

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Acronyms

Acronym	Full Form
AI	Artificial Intelligence
ASTU	Adama Science and Technology University
DBMS	Database Management System
KB	Knowledge Base
ML	Machine Learning
NLP	Natural Language Processing
UI/UX	User Interface / User Experience
CRUD	Create, Read, Update, Delete
TA	Teaching Assistant
API	Application Programming Interface

Acknowledgement

We would like to express our heartfelt appreciation to **Adama Science and Technology University (ASTU)** for giving us the opportunity to prepare and present this project proposal. Our sincere gratitude goes to our instructors and department staff for their valuable guidance, support, and encouragement throughout the proposal preparation process.

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Abstract

Managing student complaints at **Adama Science and Technology University (ASTU)** remains a largely manual and time-consuming process. Students often face delays, lack of feedback, and limited transparency when reporting issues to different departments. The existing systems do not effectively track recurring problems or reuse previously successful solutions, leading to inefficiencies and repeated concerns across the university.

This project proposes an **AI-Powered Complaint and Smart Knowledge Base System** designed to automate and enhance the complaint-handling process within ASTU. The system leverages **Artificial Intelligence (AI)**, **Natural Language Processing (NLP)**, and **Machine Learning (ML)** to classify, analyze, and manage student complaints efficiently. Students will be able to submit complaints through a user-friendly web portal, where the AI module will automatically categorize each submission and check for similar past cases stored in the dynamic Knowledge Base. If a matching solution exists, it will be suggested instantly; if not, the complaint will be routed to the appropriate department for resolution.

The system is designed to serve all three major schools within ASTU **the School of Electrical Engineering**, **the School of Mechanical Engineering**, and **the School of Civil Engineering**. Each school's organizational structure, including **students**, **academic staff**, **department heads**, and **school deans**, is incorporated into the system's workflow to ensure efficient communication and accountability.

As new complaints are resolved, their solutions are automatically added to the Knowledge Base, allowing the AI to learn continuously and improve its response accuracy over time. The project integrates modern web technologies with automated workflows, real-time tracking, and analytics for decision-making.

Expected outcomes include faster complaint resolution, improved transparency, reduced redundancy, and valuable data insights for institutional management. By introducing intelligent automation and adaptive learning, this system represents a significant advancement in how ASTU manages and responds to student concerns fostering a more efficient, transparent, and student-centered academic environment.

1. Introduction

1.1 Background

At **Adama Science and Technology University (ASTU)**, managing student complaints remains largely manual and time-consuming. Students across the three schools **School of Electrical Engineering, School of Mechanical Engineering, and School of Civil Engineering** face difficulties reporting issues related to dormitories, cafeterias, libraries, academics, or administrative services. Traditional processes often result in delays, miscommunication, and lack of transparency.

By integrating **Artificial Intelligence (AI)**, **Natural Language Processing (NLP)**, and **Machine Learning (ML)**, complaint management can be automated, faster, and data-driven. The **AI-Powered Complaint and Smart Knowledge Base System** is designed to address these challenges by classifying complaints, providing instant solutions from past cases, and offering real-time updates to students.

1.2 Purpose

The purpose of this project is to develop an intelligent, web-based complaint management system tailored for ASTU. The system enhances communication between students, academic staff, department heads, and school deans. By leveraging AI and a continuously learning Knowledge Base, complaints can be resolved efficiently while improving transparency, accountability, and institutional efficiency.

1.3 Scope

The system is designed to handle complaints across ASTU's three schools. Users include:

- ➢ **Students** – to submit and track complaints.
- ➢ **Academic Staff (Teachers)** – to review complaints.
- ➢ **Department Heads** – to approve and escalate complaints if needed.
- ➢ **School Deans** – to oversee resolution across departments.

The system will:

- ➢ Automatically suggest solutions for recurring complaints.
- ➢ Route unresolved issues to the appropriate department or authority.
- ➢ Continuously update the Knowledge Base as new cases are resolved.

1.4 Objectives

- Design a **user-friendly web portal** for complaint submission and tracking.
- Implement **AI-based text and sentiment analysis** for complaint classification.
- Automatically provide relevant solutions from the **Knowledge Base**.
- Route complaints efficiently to the correct department or authority.
- Ensure continuous learning and improvement through **Knowledge Base updates**.

1.5 Expected Outcome

The system will minimize manual effort, speed up response times, and increase transparency for all users at ASTU. Over time, it will evolve into a self-learning platform capable of automatically resolving recurring issues, improving student satisfaction, and enhancing institutional efficiency across all three schools.

2. Background of the Project

Managing student complaints is crucial for maintaining quality, accountability, and trust within educational institutions. At **Adama Science and Technology University (ASTU)**, which consists of three schools   **Electrical, Mechanical, and Civil Engineering**   the complaint-handling process remains largely manual and inefficient. Students, academic staff, department heads, and school deans face challenges in reporting, tracking, and resolving issues related to campus facilities, academics, or administrative services.

Most complaints are currently handled through paper forms, emails, or basic digital submission portals, which often results in delays, poor communication, and inconsistent resolutions. Existing systems rarely provide automated tracking, intelligent classification, or mechanisms for detecting recurring issues. Consequently, similar complaints are repeatedly submitted, consuming staff time that could be better spent on new or complex issues.

Advances in **Artificial Intelligence (AI)**, **Natural Language Processing (NLP)**, and **Machine Learning (ML)** provide an opportunity to modernize complaint management. AI can analyze unstructured complaint text, categorize issues, and match them against previously resolved cases stored in a dynamic **Knowledge Base**. This enables faster resolutions, reduces repetitive work, and provides data-driven insights for institutional decision-making.

The proposed **AI-Powered Complaint and Smart Knowledge Base System** aims to address these gaps at ASTU by automating complaint classification, suggesting solutions for recurring issues, routing unresolved complaints to the appropriate departments, and continuously learning from past cases. This approach will create a faster, smarter, and more reliable system, improving transparency, accountability, and satisfaction for both students and administrators.

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3. Statement of the Problem

At **Adama Science and Technology University (ASTU)**, managing student complaints across the three schools **Electrical, Mechanical, and Civil Engineering** is still largely manual or semi-digital. Students, academic staff, department heads, and school deans face delays and uncertainty in reporting, tracking, and resolving complaints related to dormitories, cafeterias, libraries, academics, and administrative services.

Current methods are slow, inconsistent, and lack transparency, leaving students unsure about the status or outcome of their concerns. Moreover, repeated issues require considerable staff time, as there is no mechanism to store, analyze, or reuse solutions from previously resolved complaints. Existing systems fail to detect patterns, suggest relevant solutions automatically, or support data-driven decision-making, leading to administrative overload and reduced student satisfaction.

There is a clear need for a smarter, automated system that manages complaints efficiently, learns from historical data, and provides actionable insights to improve future resolutions. The proposed **AI-Powered Complaint and Smart Knowledge Base System** seeks to address this gap by leveraging AI to classify complaints, suggest solutions from a dynamic Knowledge Base, and route unresolved complaints to the appropriate department or authority within ASTU's organizational structure.

Research Questions:

1. How can AI be applied to classify and manage student complaints efficiently across ASTU's schools and departments?
2. Can a dynamic Knowledge Base reduce repetitive complaints and improve response times for students?
3. How does automation affect transparency, accountability, and satisfaction in ASTU's complaint-handling process?

4. Objective of the Project

The objectives of this project focus on designing and implementing an **AI-driven complaint management system** tailored for **Adama Science and Technology University (ASTU)**. The system addresses inefficiencies in traditional complaint processes, emphasizing automation, accuracy, transparency, and continuous learning to improve the experience for students, staff, department heads, and school deans.

4.1 General Objective

To design and develop an **AI-Powered Complaint and Smart Knowledge Base System** that automates complaint handling, improves response time, and enhances transparency across all three schools of ASTU: **Electrical, Mechanical, and Civil Engineering**.

4.2 Specific Objectives

- ➢ To develop a **user-friendly web portal** where students can submit and track complaints across their respective schools.
- ➢ To implement **AI-based text and sentiment analysis** for automatic complaint classification.
- ➢ To integrate a **Knowledge Base** that stores resolved complaints and provides instant solutions for recurring issues.
- ➢ To enable **automatic routing** of unresolved complaints to the relevant department heads or school deans.
- ➢ To ensure the **Knowledge Base updates dynamically** as new complaints are resolved.
- ➢ To provide **real-time status tracking and notifications** to students and staff for improved transparency.
- ➢ To evaluate the system's performance in terms of **accuracy, response time, and user satisfaction** across ASTU's schools.

5. Project Rationale and Academic Merit

The **AI-Powered Complaint and Smart Knowledge Base System** is a suitable and academically challenging project for a graduation-level undertaking at **Adama Science and Technology University (ASTU)**. It combines multiple areas of computer science, including **artificial intelligence, natural language processing, database systems, and web application development**, while addressing a real-world problem within ASTU's three schools: Electrical, Mechanical, and Civil Engineering. The project demonstrates both technical skill and the ability to apply theoretical knowledge to improve institutional processes and student satisfaction.

5.1 Alignment with Core Competencies

This project aligns closely with the core principles of **Computer Science and Software Engineering**. It integrates knowledge and skills acquired during the academic program, including:

- ➢ **Algorithms and Data Structures** – for designing efficient complaint matching and classification mechanisms.
- ➢ **Database Management Systems (DBMS)** – to structure and manage the Knowledge Base and complaint records.
- ➢ **Software Design and Architecture** – applied in developing a modular, scalable web application with separate layers for AI processing, data handling, and user interface.
- ➢ **Machine Learning and Natural Language Processing (NLP)** – utilized for complaint categorization, sentiment analysis, and similarity detection.
- ➢ **Web Development and Networking** – used to create the web portal and ensure seamless communication between users and system components.

Through this integration, the project demonstrates a comprehensive application of both theoretical concepts and practical skills acquired during the degree program.

5.2 Justification of Technical Complexity

The project addresses several technical challenges that make it academically significant:

- ➢ **Natural Language Processing (NLP):** Interpreting unstructured text complaints from students and staff across multiple schools and extracting key features for classification.
- ➢ **Machine Learning Integration:** Training and fine-tuning models to recognize patterns in complaints and suggest relevant solutions accurately.
- ➢ **Dynamic Knowledge Base Management:** Designing a system capable of efficiently storing, retrieving, and updating resolved complaints.
- ➢ **System Architecture:** Coordinating interactions between the AI engine, database, and web interface in a secure, high-performance environment.
- ➢ **Data Scalability and Performance:** Handling large volumes of complaints while maintaining fast response times and accurate suggestions.

These elements ensure that the system goes beyond simple CRUD operations, providing a sophisticated, intelligent, and data-driven application.

5.3 Contribution Beyond AI-Generated Solutions

While AI tools can assist with basic code generation, this project requires **original human creativity, problem-solving, and system design**:

- ➤ **Custom Algorithm Design:** Developing unique logic for complaint similarity detection and automated solution suggestions.
- ➤ **Tailored User Experience:** Designing an interface optimized for ASTU's organizational workflow, including students, teachers, department heads, and school deans.
- ➤ **Knowledge Base Structuring:** Creating a dynamic data model that supports continuous learning and efficient information retrieval.
- ➤ **System Integration:** Manually integrating AI modules with web technologies and databases for seamless, real-time operation.

This project demonstrates intellectual effort, innovation, and technical competence, making it an appropriate and valuable final-year capstone project.

7. Deliverables

The deliverables of the **AI-Powered Complaint and Smart Knowledge Base System** comprise the tangible outputs that will be produced upon project completion to meet the needs of ASTU's students, staff, department heads, and school deans. The primary deliverable is a fully functional, user-friendly web platform that enables students to submit complaints, track progress, and view solutions, while providing administrators and school authorities with tools to manage, review, and resolve issues efficiently. Integrated within the system is an AI-driven complaint classification module that automatically analyzes complaint text, categorizes issues, and identifies recurring problems, allowing the system to suggest relevant solutions from a dynamic Knowledge Base. The Knowledge Base itself is a continuously updating repository of resolved complaints and solutions, reducing redundancy and improving response times. Additionally, the system includes automated routing and notification features that ensure unresolved complaints are directed to the appropriate department or authority, with real-time updates for all users. Comprehensive technical and user documentation will be provided, including system design, architecture, installation instructions, and operational manuals, alongside training materials for students, staff, department heads, and deans to facilitate effective system use. Each deliverable will be considered complete once it is fully functional, tested for accuracy and usability, and validated against project requirements, incorporating feedback from stakeholders to ensure it meets the institutional standards and expectations.

8. Feasibility Study

This section assesses the viability and suitability of the **AI-Powered Complaint and Smart Knowledge Base System** for **ASTU**, examining the technical, operational, and economic aspects to determine the benefits, costs, and practicality of implementing the project.

8.1 Technical Feasibility

The project is technically feasible because it leverages widely available and compatible hardware, software, and network infrastructure at ASTU. Modern web development frameworks, AI and machine learning libraries, and database management systems can be integrated seamlessly to support the system. The development team possesses the required skills and expertise to design, implement, and maintain the AI modules, Knowledge Base, and web interfaces. Additionally, the system's modular architecture ensures reliability, scalability, and maintainability, making it capable of handling complaints from students, academic staff, department heads, and school deans across ASTU's three schools.

8.2 Operational Feasibility

Operationally, the system is practical and user-friendly. It provides an intuitive web portal for students to submit and track complaints, while enabling staff, department heads, and school deans to manage and resolve issues efficiently. The AI-driven classification and Knowledge Base reduce repetitive tasks and improve response times, enhancing overall user satisfaction. Maintenance and support are manageable due to clear system design, documentation, and automated processes. The system also incorporates privacy and security measures to protect sensitive student and staff data, ensuring compliance with ASTU policies.

8.3 Economic Feasibility

To ensure the **economic feasibility** of the AI-Powered Complaint and Smart Knowledge Base System, a detailed resource and cost breakdown has been established for project development, deployment, and maintenance:

1. Hardware & Hosting:
The system will be hosted on either **AWS cloud services** ensure accessibility and reliability. The estimated hosting cost is **3,000 ETB per month**, covering server uptime, storage, and network requirements.

2. Software Tools:
Open-source and cost-effective tools are utilized wherever possible:

- ➢ **Python** for AI and NLP modules (free)
- ➢ **TensorFlow/Keras** for AI model development and deployment (free)

3. Development Tools:
Development and collaboration are facilitated using:

> ➢ **Visual Studio Code** for coding and debugging
> ➢ **GitHub** for version control and collaborative development

4. Human Resources:

> ➢ **5 Student Developers** responsible for coding, AI module integration, and testing (contributing as part of academic requirements)
> ➢ **1 Faculty Supervisor** overseeing project progress, providing guidance, and ensuring quality

9. Significance of the Project

The **AI-Powered Complaint and Smart Knowledge Base System** holds significant importance for **ASTU** and the broader educational community. By automating complaint management, the system ensures faster resolution, improved transparency, and enhanced accountability, addressing long-standing inefficiencies in manual processes. The integration of AI and a dynamic Knowledge Base allows recurring complaints to be identified and resolved automatically, reducing administrative workload and improving decision-making. For the institution, the system provides valuable data insights that can guide policy, prevent recurring issues, and enhance overall operational efficiency. For students and staff, it creates a more responsive and reliable communication channel, fostering trust and satisfaction. In a broader context, this project demonstrates how AI-driven solutions can transform service management in educational institutions, contributing to research and best practices in intelligent administrative systems.

10. Beneficiaries of the Project

The primary beneficiaries of this project include students, academic staff, department heads, and school deans across ASTU's three schools: **Electrical, Mechanical, and Civil Engineering**.

> ➢ **Students** benefit by having a convenient platform to submit complaints, track their status in real time, and receive solutions promptly, improving their overall experience and satisfaction.
> ➢ **Academic Staff (Teachers)** can efficiently review complaints, provide feedback, and collaborate with department heads to ensure timely resolution.
> ➢ **Department Heads** benefit from automated routing and prioritization of complaints, allowing them to focus on critical issues while reducing redundant administrative tasks.
> ➢ **School Deans** gain a holistic view of recurring complaints, enabling them to make informed decisions, implement preventive measures, and ensure accountability across their schools.

Additionally, the institution as a whole benefits from improved operational efficiency, reduced repetitive workload, and data-driven insights that support policy-making and service quality

improvements. Overall, the system creates value for all stakeholders by fostering a more organized, transparent, and responsive complaint management process.

11. Methodology

The methodology for the **AI-Powered Complaint and Smart Knowledge Base System** follows a structured approach to ensure the system is efficiently planned, designed, implemented, and evaluated. The project development is divided into key phases, including **requirement analysis, system design, implementation, testing, deployment, and evaluation**.

- ➢ **Requirement Analysis:** This phase involves gathering detailed information from ASTU stakeholders, including students, academic staff, department heads, and school deans, to identify functional and non-functional requirements of the complaint management system.
- ➢ **System Design:** In this phase, the overall architecture of the system is defined. It includes designing the web portal interface, AI-driven complaint classification module, Knowledge Base structure, database schema, and workflow for complaint routing and notifications.
- ➢ **Implementation:** The system is developed using modern web technologies integrated with AI and NLP modules. This phase involves coding the front-end, back-end, database, and AI components, ensuring seamless interaction between all modules.
- ➢ **Testing:** The system is rigorously tested for functionality, usability, performance, and security. Both unit testing and integration testing are conducted to ensure that the complaint submission, AI classification, Knowledge Base retrieval, and routing processes operate correctly.
- ➢ **Deployment:** The system is deployed on ASTU's servers, ensuring accessibility for all users across the three schools. Necessary configurations for network, security, and user access are applied.
- ➢ **Evaluation:** Finally, the system is evaluated based on criteria such as accuracy of AI classification, response time, user satisfaction, and overall effectiveness in resolving complaints efficiently. Feedback from stakeholders is used to refine and improve the system.

11.1 Development Tools

The project uses a combination of modern technologies and tools to develop a robust, intelligent complaint management system:

- ➢ **Programming Languages:** Python (for AI/NLP modules), React (Typescripts) (for front-end interactivity), and Node.js (for back-end logic).
- ➢ **Web Frameworks:** Fast API for Python-based back-end, React (Typescripts) for front-end development.
- ➢ **Databases:** PostgreSQL for structured complaint data storage and Knowledge Base management.

- ➢ **AI and Machine Learning Libraries:** TensorFlow, Keras, or scikit-learn for complaint classification and similarity detection; NLTK or spaCy for natural language processing and sentiment analysis.
- ➢ **Development Environment:** Visual Studio Code for coding and debugging.
- ➢ **Version Control:** Git and GitHub or GitLab for source code management and collaboration.

These tools collectively enable the development of a **scalable, secure, and intelligent complaint management system** tailored for ASTU, integrating AI-driven automation with a dynamic Knowledge Base and user-friendly web interface.

12. Required Resources and Cost

The successful development and implementation of the **AI-Powered Complaint and Smart Knowledge Base System** require a combination of human, material, financial, and infrastructural resources.

Human Resources: The project team will include developers with expertise in AI, NLP, web development, and database management. In addition, stakeholders such as students, academic staff, department heads, and school deans will provide input for requirement analysis, testing, and evaluation.

Material and Equipment: The system will require computers or laptops for development and testing, servers for deployment, and network infrastructure to support web access across ASTU's three schools.

Software and Tools: Development tools include programming languages (Python, JavaScript), web frameworks (Fast API, React), databases (PostgreSQL), AI libraries (TensorFlow, scikit-learn, spaCy), and development environments (Visual Studio Code,). Version control tools such as Git and GitHub/GitLab will support collaboration.

Financial Resources: Costs are primarily associated with software licenses (if any), server hosting, and internet/data usage. Using open-source technologies and existing ASTU infrastructure minimizes expenses.

Time Resources: The project is planned to be completed over a defined schedule (e.g., 6–8 months), with each development phase allocated sufficient time for analysis, design, implementation, testing, and deployment.

Overall, the resources are manageable, cost-effective, and sufficient to ensure the successful implementation of the system.

13. Tasks and Schedule

13.1 Tasks and Schedule Breakdown

The project follows a structured timeline, divided into clear tasks and milestones to ensure systematic development and completion.

Phase	Duration	Key Activities	Milestone
Requirement Analysis	3–4 weeks	Gathering detailed input from students, staff, department heads, and deans	Completion of requirement gathering
System Design	4–5 weeks	Creating architecture, workflow, Knowledge Base structure, and user interface mockups	Approval of system design
Development / Implementation	10–12 weeks	Coding front-end, back-end, AI modules, and Knowledge Base integration	Completion of development and AI integration
Testing	4–5 weeks	Conducting unit testing, integration testing, and user acceptance testing	Successful testing and validation
Deployment	2 weeks	Installing system on ASTU servers and configuring access for all users	Deployment and live operation
Evaluation and Refinement	3–4 weeks	Measuring performance, AI accuracy, user satisfaction, and system refinement	Final evaluation and project closure

Table 1: Project Task Breakdown and Timeline

13.1 Project Summary

Metric	Details
Total Project Duration	4-6 months
Total Weeks	26–32 weeks
Number of Phases	6
Number of Milestones	6

Table 2: **Project Summary**

14. Team Composition

Team Member	Assigned Role(s)	Main Responsibilities
Abduselam Mohammednur	Project Manager, System Developer	Coordinates project activities, manages timeline and resources, oversees development and integration
Abuzer Jemal	System Analyst, Backend Developer	Gathers and analyzes requirements, creates system specifications, designs and implements AI components
Abyalew Lobe	System Designer, Backend Developer	Designs system architecture, plans database and backend structure, implements backend components
Biniyam Biyadge	Frontend Developer, System Tester	Develops web interface, ensures usability, conducts system and integration testing
Abdurahman Sualih	Frontend Developer, System Evaluator	Builds user portal, participates in UX/UI design, evaluates system performance and gathers user feedback

Table 3   Team Composition

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