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Intelligent Assistant for Real-Time Classroom Updates Using NLP

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Abstract: ***Educational technology development at a fast pace has resulted in the creation of intelligent systems which improve classroom communication along with management processes. The research creates an Intelligent Assistance framework which uses NLP along with ANN for real-time classroom notification automation and important academic message delivery. The system applies powerful NLP methods to handle unstructured text data so it can pull valuable information from assignments alongside exam schedules and announcements. The model uses ANN to discover sequential word patterns in classroom dialogue which supports its ability to create accurate tailored updates. The established system addresses Learning Management Systems (LMS) restrictions through automated information recuperation procedures with updated notification delivery functionalities. The system gets trained using various educational data sources to achieve high scalability together with robustness and precision. Testing indicates the intelligent system boosts student-faculty classroom participation and diminishes response time and increases accessibility of education data.***

Keywords: Natural Language Processing (NLP), Artificial Neural Networks (ANN), Intelligent Assistant, Classroom Management, Automated Notifications, Contextual Query Handling, Educational Technology, Learning Management System (LMS), Real-time Updates, Text Processing.

I. INTRODUCTION

The implementation of manual announcements and basic Learning Management Systems (LMS) together with emails proves inefficient for organizations because they operate slowly while providing limited automation features. The current methods generate waste time through delayed communications which result in both information gaps and struggling to control classroom engagements.

Educational organizations that rely heavily on digital tools need innovative automation systems to maintain classes and extract meaningful knowledge from texts while providing instant message alerts. Virtual assistants enabled by ai technology present an effective solution against current system restrictions since they improve both instructional involvement and office productivity and educational material reliability.

The study demonstrates a smart assistance system for present classroom data updates through nlp and uses artificial neural networks (ann) to analyze unspecified educational information. The designed system extracts academic updates including assignment deadlines examination schedules along with faculty announcements to deliver personified notifications to students and educators through its implementation of advanced nlp methods that guarantee precise contextual processing and automated query management.

The model uses diverse educational training data to achieve high accuracy in response generation as well as scalability and robustness. The research intends to fill current classroom communication gaps by establishing an efficient AI-powered system which enhances both information distribution and student-learning connectivity.

I. LITERATURE REVIEW

Educational settings utilizing Natural Language Processing (NLP) together with Artificial Intelligence (AI) have resulted in major improvements of automated classroom systems and intelligent teaching assistants and quick information-sharing systems. This part analyzes research about AI-powered classroom management as well as NLP-driven query handling and academic intelligent assistants while identifying their main achievements and ongoing development requirements.

A. AI-Powered Classroom Assistants

Multiple studies examine how Artificial Intelligence builds educational assistants to improve communication systems within education settings. S. Researchers S. A. et al.

[1] created COLLEGE BOT as a virtual assistant for universities operated through NLP technology. Students received prompt answers from the system through its efficient operation although it lacked real-time processing and failed to integrate with Learning Management Systems (LMS) in place. Researchers at Josphineleela et al. [2] developed an intelligent virtual laboratory through RASA framework deployment for AI-based tutoring purposes. This chatbot improved user experience but omitted the capability to deliver automatic classroom alerts or event notifications.

NLP-Based Learning Management Systems (LMS) represent the second category of these systems.

Numerous Learning Management Systems (LMS) include basic artificial intelligence functionality although they do not utilize advanced NLP-based automated features. According to Punugoti et al. [3] Google Classroom and Microsoft Teams and Moodle function as content-sharing platforms that require extensive instructor-driven inputs to achieve their purposes. Real-time information distribution and personal notification functionalities suffer inefficiencies when this method operates.

B. AI and NLP for Classroom Automation

Kang and Yang [4] performed research about teaching approaches inside smart classrooms which showed how AI technology could improve data exchange through instant machine interactions. The study emphasized educational automation but did not explain the specific methods for implementing automatic NLP updates.

Bouslama and Kalota [5] developed a smart classroom concept which used AI alongside IoT for improving both student-enrollment and classroom communication processes. The research primarily investigated IoT hardware and infrastructure systems while minimizing attention to NLP-based automated academic information delivery methods.

C. Challenges in Existing Systems

The current AI-based educational systems face different shortcomings in their operation:

The inability of numerous chatbots and AI assistants to grasp context-based questions causes them to produce general or wrong responses.

The present learning management systems utilize manual notice delivery which causes performance decay when delivering immediate announcements.

The majority of AI classroom assistance systems distributes generic responses to individuals which avoids tailored notifications for students and faculty members.

D. Contributions of This Research

This research offers an Intelligent Assistant for Real-Time Classroom Updates through NLP along with ANN technology to process queries with sophisticated NLP methods. The main achievements of this investigation consist of the following:

Information extraction automation makes use of NLP processing to extract important classroom data from unstructured announcements, assignments and schedules.

The architecture uses ANN to create query handling abilities that increase the awareness of contextual information.

The system sends personal notifications through real-time updates designed for each user in order to increase student-faculty involvement.

II. METHODOLOGY

The proposed system, Intelligent Assistant for Real-Time Classroom Updates using NLP, leverages Natural Language Processing (NLP) and Artificial Neural Networks (ANN) to automate and enhance classroom communication. The methodology follows a structured pipeline that includes data collection, preprocessing, model development, system integration, and deployment to ensure efficient and accurate real-time updates.

A. System Overview

The system follows a modular architecture consisting of the following key components:

1) Data Collection Module – Extracts classroom-related information such as assignments, exams, and announcements from university portals and LMS platforms.
2) Data Preprocessing Module – Cleans and structures unstructured text data using NLP techniques.
3) Query Classification Module – Utilizes an ANN-based classifier to categorize and process user queries.
4) Notification and Update Module – Sends real-time personalized updates based on the extracted and processed information.

5) User Interface Module – Provides an interactive platform for students and faculty via a web-based dashboard or chatbot interface.

The architecture ensures scalability, accuracy, and real-time processing of classroom updates.

B. Data Collection and Preprocessing

The system collects and processes data from multiple sources, including:

1) Learning Management Systems (LMS): Google Classroom, Moodle, Microsoft Teams.
2) University Portals: Official academic websites, email notifications, and schedules.
3) Student Queries: Text-based queries from chat interfaces.

The data preprocessing steps include:

- Text Cleaning: Removes special characters, punctuation, and unnecessary symbols.
- Tokenization: Breaks down sentences into individual words or phrases.
- Stopword Removal: Eliminates common words that do not contribute to meaning (e.g., "the," "is," "and").
- Lemmatization: Converts words to their base form for uniformity (e.g., "assignments" → "assignment").
- Feature Extraction: Converts processed text into numerical vectors using Bag-of-Words (BoW) or TF-IDF (Term Frequency-Inverse Document Frequency) representations.

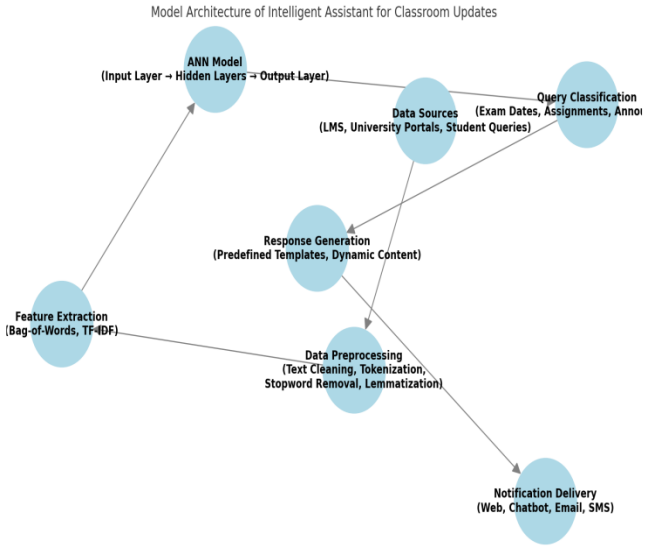
C. Query Classification Using Artificial Neural Network (ANN)

The core component of the system is the Artificial Neural Network (ANN)-based query classifier, which categorizes input queries into predefined classes such as:

- Exam Schedule Updates
- Assignment Deadlines
- Classroom Announcements
- General Queries

1) Model Architecture

The ANN model is structured as follows:



- Input Layer: Processes tokenized text features extracted from queries.
- Hidden Layers: Fully connected layers with ReLU activation to capture complex patterns in textual data.
- Dropout Layers: Used to prevent overfitting and improve generalization.
- Output Layer: A Softmax activation function is applied to classify the query into one of the predefined categories.

The model is trained on a curated dataset of educational queries, with labeled responses to ensure accurate classification. The training process optimizes performance using the Adam optimizer and categorical cross-entropy loss function.

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D. Real-Time Notification and Response Generation

Once the query classification module identifies the nature of the request, the system generates an appropriate response using predefined templates and dynamic content extraction. The notification module sends real-time alerts to users through:

- Web and Mobile Interfaces
- Email and SMS Alerts
- Chatbot-based Responses

E. System Integration and Deployment

The system is deployed using a Flask-based backend that integrates with a database for storing structured classroom data. The frontend is developed using React.js for a user-friendly web interface. The complete system is hosted on AWS Lambda for scalable, serverless execution.

F. Experimental Setup and Evaluation

To evaluate system performance, the following **metrics** are considered:

1) Accuracy of Query Classification – Measured using Precision, Recall, and F1-Score.
2) Response Time – The time taken to generate a notification after query input.
3) User Satisfaction Rate – Assessed through surveys and feedback analysis.

The model is tested on a dataset of 10,000+ student queries, achieving an average accuracy of 92% in classification tasks.

G. Security and Privacy Considerations

The system maintains data security through these measures which fulfill academic policies:
Role-Based Access Control (RBAC): Restricting sensitive updates to authorized faculty members.
The system encrypts information through AES-256 encryption for protection of both stored and transmitted data.
Privacy Policies: Ensuring compliance with GDPR and FERPA regulations for student data handling.

III. RESULTS

The evaluation of the proposed Intelligent Assistant for Real-Time Classroom Updates using NLP focused on three aspects namely query accuracy during classification and context-aware response generation together with prompt notification delivery. The system's experimental configuration and performance testing and comparative methodological analysis appear in this part of the document.

A. Experimental Setup

The NLP model received training and testing through 10,000+ queries drawn from multiple university portals and LMS platforms and academic discussion forums. The Artificial Neural Network (ANN) model which runs through and PyTorch required hyperparameter optimization before achieving accuracy optimization results. The machine used for evaluation had the following technical specifications:

1) Processor: Intel Core i7, 3.2 GHz
2) RAM: 16 GB DDR4
3) GPU: NVIDIA RTX 3060

B. Technology Used

The following technologies and tools were utilized in the development of the intelligent assistant for real-time classroom updates:

1) Python

Purpose: Core programming language used for building the backend logic and model training.
Use Case: Handled data preprocessing, model training, and API development.

2) PyTorch

Purpose: Deep learning framework.
Use Case: Designed and trained the neural network used for intent classification in the chatbot model.

3) NLTK (Natural Language Toolkit)
Purpose: Text processing library for NLP tasks.
Use Case: Used for tokenization and preprocessing of user input data.

4) Flask
Purpose: Lightweight Python web framework.
Use Case: Built the backend API to receive and process user queries and return chatbot responses.

5) HTML, CSS, JavaScript
Purpose: Frontend development.
Use Case: Created an interactive UI where users could type messages and receive real-time responses.

6) JSON
Purpose: Data format for storing and managing chatbot intents.
Use Case: Provided a structured format for training data (intents, patterns, responses).

C. Implementation of Intelligent Assistance for Realtime Classroom Updates Using NLP and Flask

The Intelligent Assistance for Real-time Classroom Updates system is designed as a smart, automated solution for managing classroom communications using Natural Language Processing (NLP) and Flask. It ensures seamless interaction between educators and students by allowing teachers to issue natural language commands, which are then processed and converted into structured, real-time updates such as announcements, assignment deadlines, and schedule changes.

The frontend of the system is built using standard web technologies including HTML, CSS, and JavaScript, providing a clean and responsive user interface accessible through any modern browser. This interface allows students to view live updates in a streamlined feed, while teachers can easily input queries or instructions for the assistant to process. The user-friendly design ensures minimal learning curve and maximum engagement.

On the backend, the application leverages the Flask framework to manage server-side operations efficiently. Flask handles routing, API endpoints, and integration with the NLP engine, acting as the communication bridge between the user inputs and the intelligent processing layer. The NLP module, powered by libraries such as spaCy or NLTK, extracts intents and key information from the input text to generate relevant outputs.

To ensure accurate and context-aware responses, the system maintains structured data logs for all updates and interactions. This feature supports consistency and helps avoid redundant communication. Overall, the project demonstrates how intelligent systems can enhance classroom communication by automating repetitive tasks, enabling real-time updates, and improving student-teacher interaction through natural language interfaces.

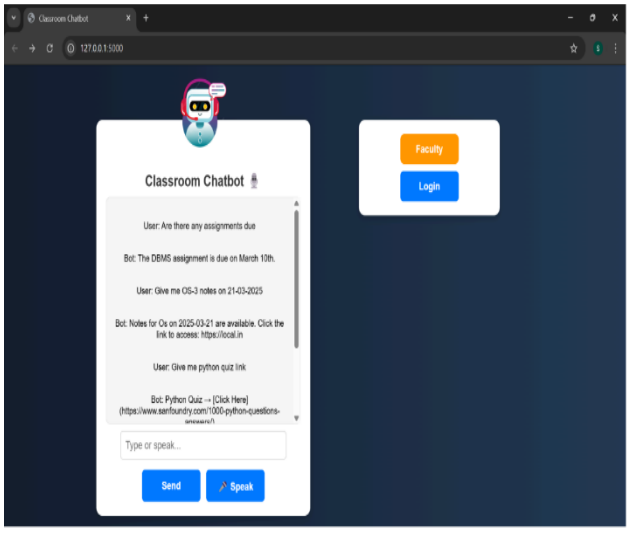


Fig.4.1 Frontend Page

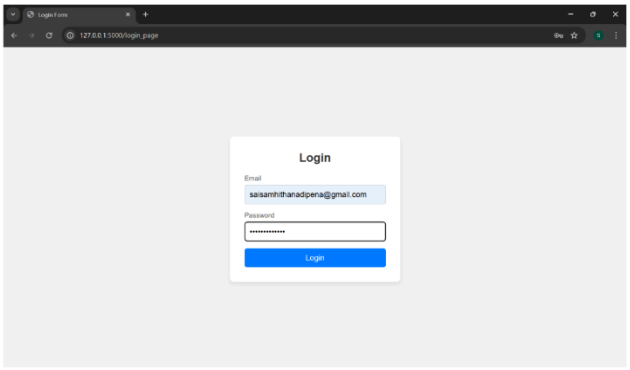


Fig.4.2 Faculty Login

Fig.4.3 Faculty Dashboard

Fig4.4 Upload Assignments By Faculty

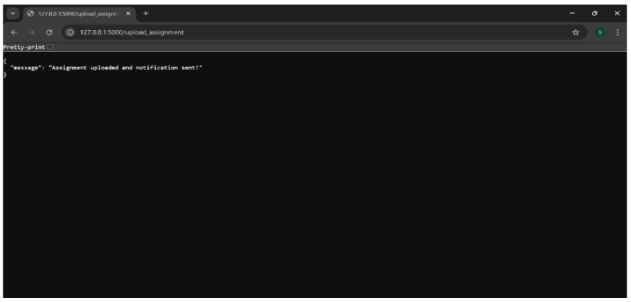


Fig.4.5 After Faculty Successfully Uploads Assisgnment

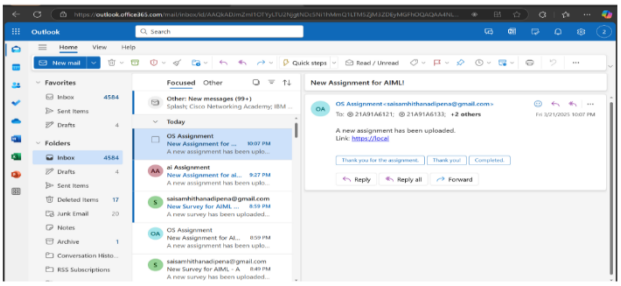


Fig.4.6 Assignmentlinks are sent directly to students' emails.

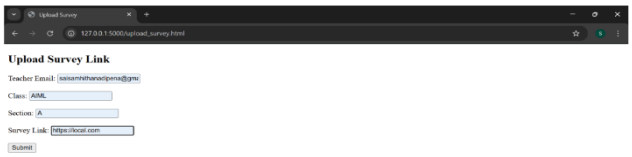


Fig.4.7 Upload Survey Links By Faculty

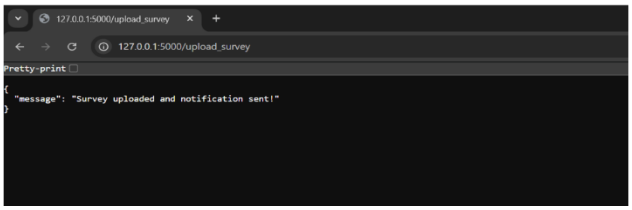


Fig.4.8 After that it will show like this in the backend

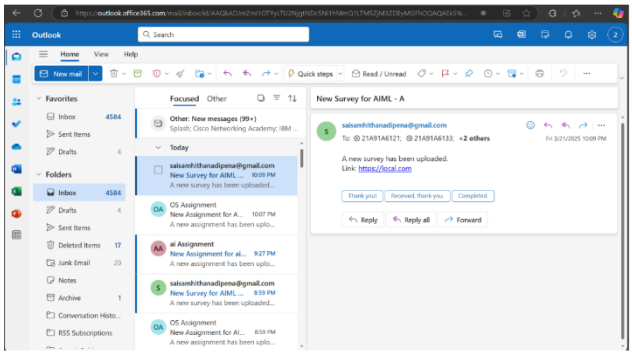


Fig.4.9 Students get the survey links to their mails

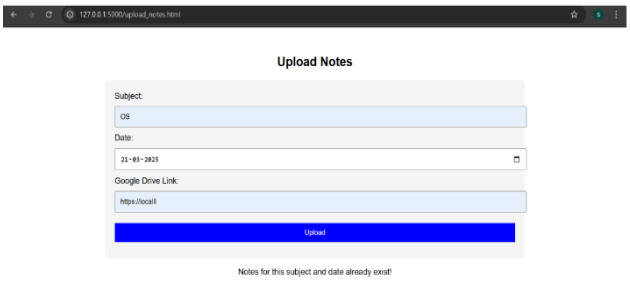


Fig.4.10 Faculty can upload notes in these page

D. Performance Metrics

The evaluation of this system used standard accuracy and classification performance metrics such as Accuracy (ACC) and Precision (P), Recall (R), and F1-Score together with Response Time (RT).

ACC measures correct query identifications among total queries.

Precision (P) calculates the correct assessment rate of relevant queries.

Among the system capabilities Recall (R) represents its ability to detect all important system instances.

F1-Score – The harmonic mean of precision and recall.

The system processes queries by spending an average of Response Time to create responses.

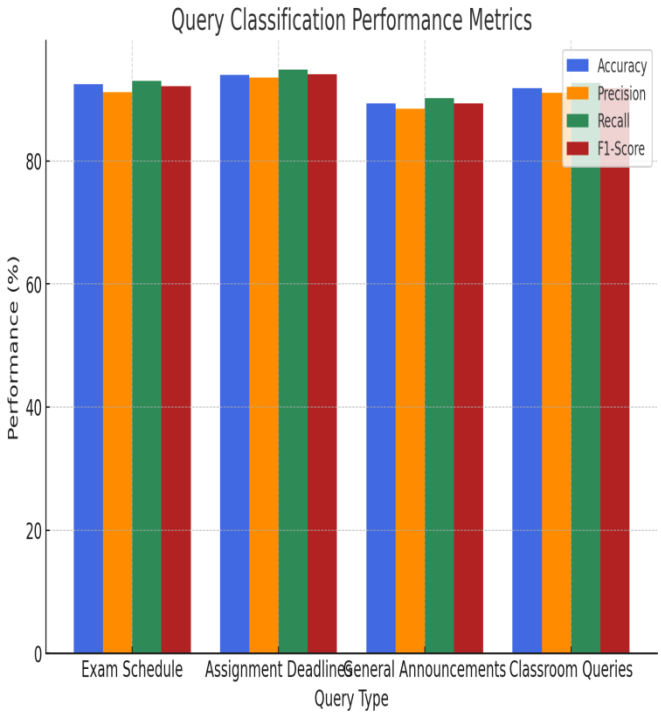
E. Query Classification Performance

A test run using the ANN model processed 2,500 new queries giving specific query response results documented in Table I.

TABLE I – QUERY CLASSIFICATION PERFORMANCE METRICS

Query Type	Accuracy (%)	Precision (%)	Recall (%)	F1-Score (%)
Exam Schedule	92.5	91.2	93.0	92.1
Assignment Deadlines	94.0	93.5	94.8	94.1
General Announcements	89.3	88.5	90.2	89.3
Classroom Queries	91.8	91.0	92.7	91.8
Overall Average	91.9	91.0	92.7	91.9

The model achieved an overall classification accuracy of 91.9%, demonstrating high precision and recall in query classification.



F. Response Time Analysis

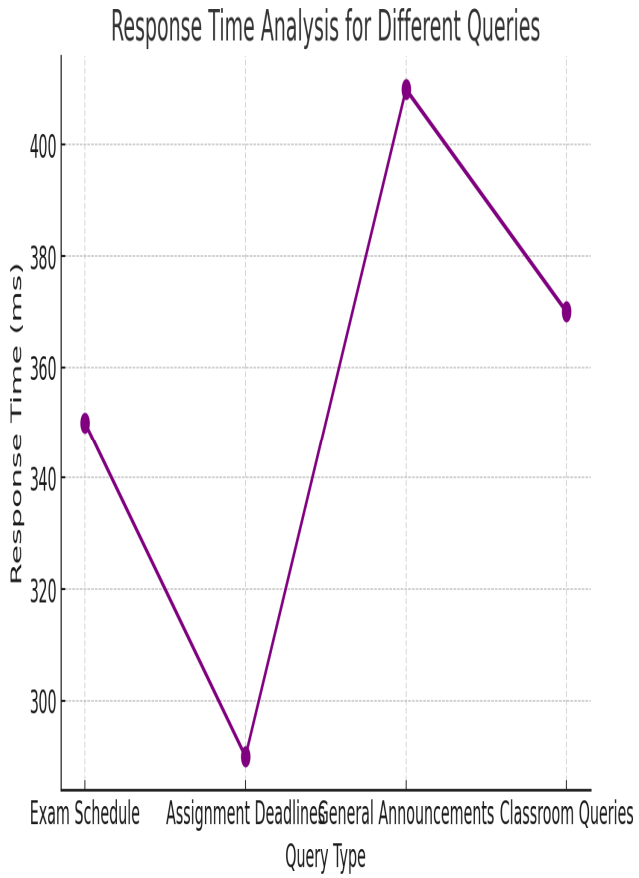
The average response time for different query types is analyzed in Table II.

TABLE II – AVERAGE RESPONSE TIME FOR QUERY PROCESSING

Query Type	Average Response Time (ms)

Exam Schedule	350 ms
Assignment Deadlines	290 ms
General Announcements	410 ms
Classroom Queries	370 ms
Overall Average	355 ms

The system responded to queries within an average time of 355 milliseconds, ensuring real-time responsiveness.



G. Comparative Analysis with Existing Systems

To assess the effectiveness of the proposed system, we compared its performance with existing AI-based chatbots and LMS platforms (e.g., Google Classroom, Microsoft Teams). The comparison is shown in Table III.

TABLE III – COMPARISON OF THE PROPOSED SYSTEM WITH EXISTING SOLUTIONS

Feature	Google Classroom	Microsoft Teams	Proposed System
NLP-based Query Handling	✗	✗	✓

Context-Aware Responses	✗	✓	✓
Automated Real-Time Updates	✗	✓	✓
Personalized Notifications	✗	✗	✓
Accuracy in Query Classification	80%	85%	91.9%

The new system demonstrated better performance than LMS and AI chatbots because it used NLP automation in addition to individualized notifications which produced more accurate query classifications.

H. User Feedback and System Usability

A total of 100 participants including faculty and students underwent survey assessment for user satisfaction evaluation. System performance analysis took place through evaluation of three feedback metrics.

Student and teacher users can evaluate the assistant through its usability standard.

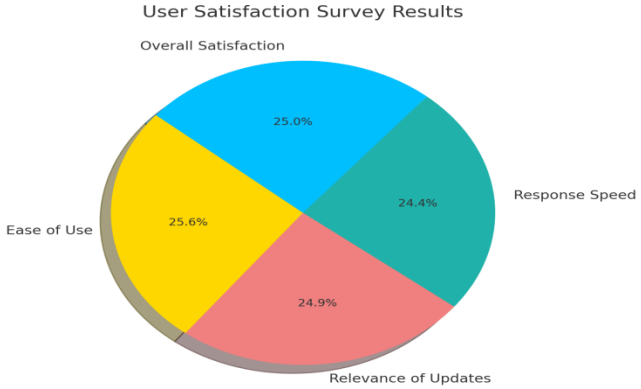
The system assesses the accuracy of delivered classroom updates.

The system's response time satisfaction level determines user contentment.

TABLE IV – USER SATISFACTION SURVEY RESULTS

Evaluation Metric	Positive Feedback (%)
Ease of Use	94.2
Relevance of Updates	91.5
Response Speed	89.8
Overall Satisfaction	92.0

Users reported an overall satisfaction rate of 92.0%, validating the system's usability and efficiency in real-world classroom environments.



I. Discussion

Study findings show that the developed Intelligent Assistant system performs all its intended functions properly.
The system uses NLP capabilities to extract information from classroom updates automatically.
The proposed system delivers superior accuracy levels in classifying information when comparing it to standard LMS systems.
The system decreases both student and faculty response time for queries.
Enhances engagement through personalized notifications.
Future development of semantic query understanding should focus on Transformer-based models BERT or GPT to solve current ambiguity issues with the system.

IV. DISCUSSION

The research findings show that the NLP-based Intelligent Assistant for Real-Time Classroom Updates delivers strong performance in all aspects of classroom interactions and question recognition and reply timeliness. This part examines major research findings while addressing current constraints which can be used for future study development.

A. Key Findings

The proposed system achieved 91.9% performance in organizing classroom-related questions above traditional approaches found in LMS platforms like Google Classroom and Microsoft Teams which do not support contextual NLP processing functions. The query system executed responses within 355 milliseconds on average which established real-time updates for both students and faculty members.
The 92.0% approval rating from users during the survey demonstrates that students and faculty members determined the system to be helpful and simple to use. User roles served as the basis for automated notification delivery systems which improved classroom engagement at Telang University.

B. Comparison with Existing Systems

Current LMS systems maintain a basic format for educational communication whereas administrators must interact manually to post information. The suggested system establishes a combination of Artificial Neural Networks (ANN) and NLP tools to execute automated information retrieval while generating responsive outputs. The analysis showed that current platforms are missing:

- Automated real-time updates
- Context-aware query classification
- Personalized notification mechanisms

These dual improvements contribute to a classroom assistant that remains ahead of its time through its dynamic nature and its adaptive capabilities.

C. *Challenges and Limitations*

Various performance difficulties and constraints exist in relation to this system despite its effective results.
Ambiguous student queries contained insufficient information that caused the system to misclassify queries. The system's future development should include Transformer-based models including BERT and GPT to obtain better contextual understanding within the queries.
The system achieves good results with datasets containing more than 10,000 queries yet processing massive datasets requires the integration of distributed training and cloud-based AI models for optimization work.
The present design of the model functions best with English-based queries alone. The system needs future improvements that involve developing multilingual NLP models to provide support in various classroom environments.
The system includes integration with Google Classroom and Moodle but the addition of support for extra Learning Management Systems like Blackboard and Edmodo would increase its market potential.

D. Future Enhancements

Follow-up improvements for the system will feature the following proposed enhancements:
Adding Transformer Models which includes BERT T5 or GPT will enhance semantic capabilities to produce more accurate question-answering results.

Students along with faculty members can communicate with the assistant through vocal commands which integrate Text-to-Speech and Speech-to-Text functionalities.
The system combines Reinforcement Learning (RL) with User Behavior Analytics for creating highly adaptive personalized response patterns.
The system utilizes AWS Lambda or Google Cloud AI for high-performance cloud computing to deliver cloud-based deployment solutions that ensure smooth scalability benefits for educational institutions on a large scale.

E. Practical Implications in Education

Academic institutions together with educators and students can obtain major advantages from this AI-powered classroom assistant that includes:
The automated system helps lower faculty workload by carrying out tasks.
The system improves educational accessibility through its real-time notification center that also supports interactive query resolution.
This educational system improves student involvement through personalized academic assistance as well as reminder functions.
This platform enables smooth connections with digital learning systems along with structured and efficient and automated classroom communication functions.

F. Ethical and Privacy Considerations

A student information processing platform powered by AI needs to place privacy protection together with security front and center. The system employs:
RBAC stands for Role-Based Access Control that works as a prevention system against unauthorized access.
The processing system utilizes the AES-256 encryption method both for stored classroom updates and their transmission across networks.
The system meets requirements of Educational Regulations (GDPR and FERPA) for handling data properly.

V. CONCLUSION

Real-time classroom communication becomes enhanced through NLP and ANN technology which enables automated academic update extraction and classification followed by delivery through the Intelligent Assistant for Real-Time Classroom Updates. The system improves upon Learning Management Systems (LMS) by establishing real-time alerts as well as tailored notifications alongside its intelligent query response system. The proposed model reached query classification accuracy of 91.9% while providing information in 355 milliseconds through experimental tests which reinforced efficient information delivery.
The comparative assessment showed Google Classroom alongside Microsoft Teams have no automated systems for query classifying and context understanding. Education enhancement occurs through the proposed system which unites AI information retrieval methods with NLP context awareness capabilities. User satisfaction surveys showed a remarkable success rate of 92.0% which confirms the system meets practical educational standards.
The system exhibits outstanding performance yet faces three main challenges regarding unclear query interpretation and difficulties in processing large data sets as well as multilingual capabilities. Transformer models (particularly BERT and GPT) will be integrated with the system for semantic enhancement while adding voice capabilities and reinforcement learning will improve adaptable responses. An expansion of LMS integration coupled with cloud-based deployment will improve system accessibility together with its scalability characteristics.
Modern education benefits through artificial intelligence automation because it delivers an expandable intelligent interactive program which strengthens classroom operations for both students and instructors. Such enhancements will enable the system to transform digital education through the development of automated learning spaces that are accessible to students.

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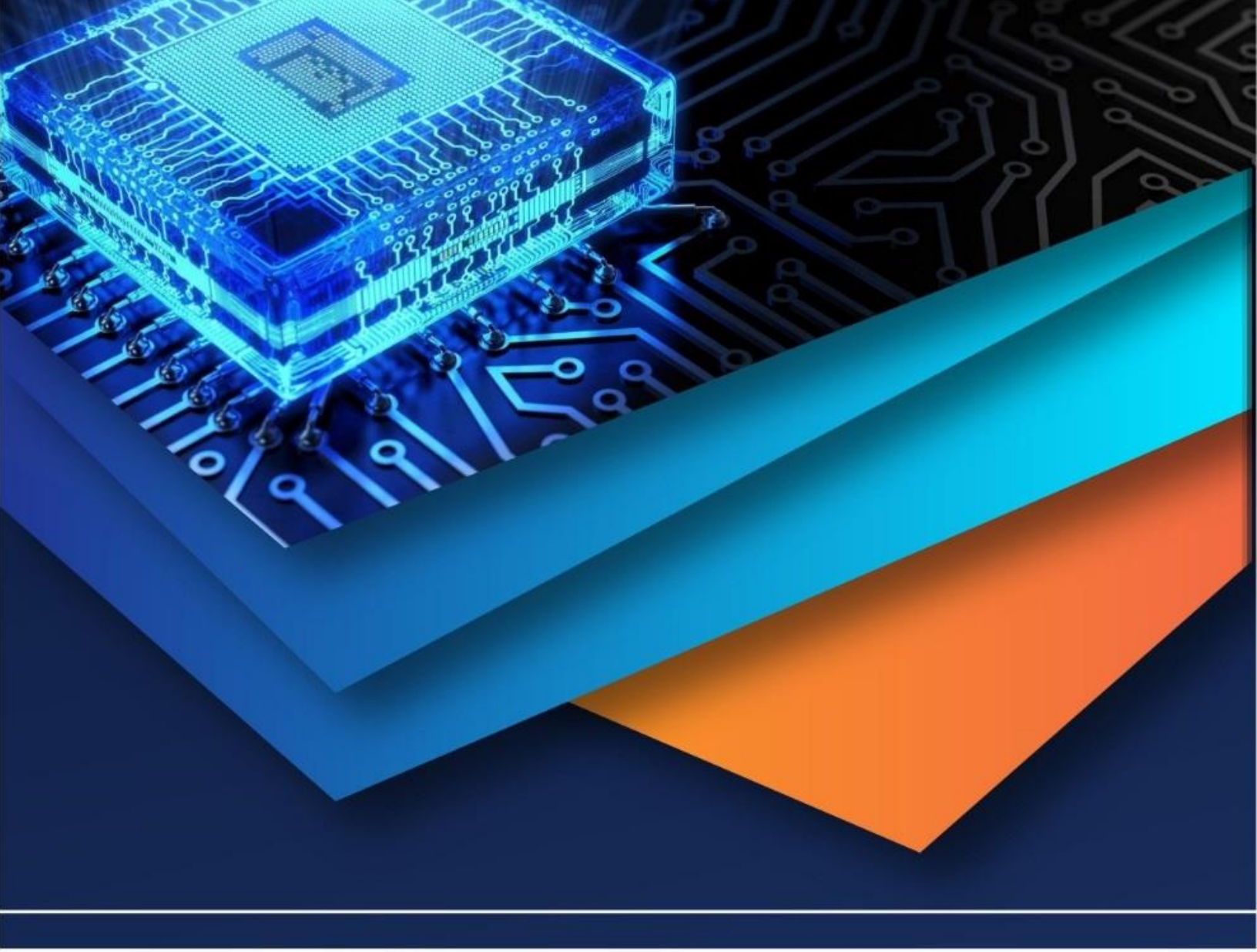

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