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AI Driven Handwritten Assignment Analysis and Evaluation

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Abstract: ***Manual evaluation of handwritten assignments is a time-consuming and labor-intensive process that burdens faculty members in educational institutions. This paper presents a novel AI-driven system designed to automate the evaluation of handwritten assignments using Optical Character Recognition (OCR) and Natural Language Processing (NLP). The system ensures accuracy, consistency, and efficiency in grading while reducing administrative workload. Unique assignment questions are generated from a robust question bank and distributed via institutional email. Students submit scanned handwritten responses through a dedicated portal, where OCR converts the images into editable text. An NLP engine then evaluates the submissions based on rubric-based grading criteria. Results are stored in an Excel sheet, readily accessible to faculty. This scalable solution enhances academic integrity, facilitates seamless evaluation, and can be integrated into modern educational workflows.***

Keywords: Automated Evaluation, OCR, NLP, AI in Education, Handwritten Assignments, Rubric-Based Grading, Academic Integrity

I. INTRODUCTION

The increasing volume of student assignments in educational institutions has placed a significant burden on faculty members, who must manually evaluate each submission. This not only consumes valuable time but also introduces the potential for human error and inconsistency. To address these challenges, this project presents an AI-driven solution designed to automate the evaluation of handwritten student assignments, enhancing overall efficiency and ensuring standardized grading.

At the core of the system is a dynamic question bank, which serves as the foundation for generating unique and randomized assignment questions for each student. These questions are automatically selected and securely sent to students via their registered college email addresses. Simultaneously, the questions are recorded in a centralized database, mapped to each student's roll number for future reference and tracking.

Students complete their handwritten assignments and upload them through a dedicated online portal. Once uploaded, the system employs Optical Character Recognition (OCR) technology to convert the handwritten content into machine-readable text. This conversion enables the next stage, where Natural Language Processing (NLP) algorithms analyze and evaluate the responses based on predefined rubric-based grading criteria. The use of NLP ensures that the evaluation is contextually accurate, consistent, and aligned with the learning objectives.

Following the automated assessment, the system calculates scores and compiles the results into an Excel sheet for easy access and review by faculty members. This comprehensive approach not only minimizes manual effort but also promotes fairness, accuracy, and transparency in the grading process. By integrating AI technologies into the academic workflow, the project contributes to maintaining academic integrity while modernizing the evaluation process in educational institutions.

II. LITERATURE SURVEY

A. AI-Based Automated Essay Grading System using NLP

The use of Natural Language Processing (NLP) has significantly enhanced the automation of essay and answer evaluation. This paper explores how NLP techniques, such as semantic similarity and syntactic parsing, can assess the relevance and coherence of student-written responses.

It demonstrates the replacement of traditional keyword-based scoring with context-aware models, offering more consistent and objective evaluations. The study also emphasizes scalability and reduced human workload, making it highly applicable to educational systems requiring automated, real-time assessment.

B. Advancing Optical Character Recognition for Handwritten Text

Handwritten text recognition remains a challenging problem in OCR, especially in educational contexts where students submit non-digital scripts.

This study provides an in-depth analysis of OCR advancements for cursive and unconstrained handwriting. It reviews the integration of machine learning and image preprocessing methods to improve character segmentation, noise reduction, and recognition accuracy. The paper highlights the critical role of OCR in converting handwritten content into machine-readable text for further analysis using NLP tools.

C. NLP-Based Automatic Answer Evaluation

This paper focuses on using NLP algorithms to semantically compare student answers with model answers, regardless of writing style or word choice.

The authors propose methods like sentence embeddings, cosine similarity, and transformer-based models (e.g., BERT) to capture contextual understanding. The approach is particularly effective in short-answer and descriptive evaluations where surface-level keyword matching fails. This aligns closely with the objective of your project to grade handwritten responses with deeper comprehension and fairness.

D. Improved Automated Essay Grading System via Natural Language Processing and Deep Learning

By combining NLP and deep learning, this study introduces a robust framework for essay grading that improves accuracy and consistency.

The paper utilizes neural network architectures to learn grading patterns from large datasets and accounts for essay quality indicators such as coherence, relevance, and grammar. It addresses biases present in traditional grading and suggests an architecture that can be adapted for multiple educational use cases, including handwritten assignment evaluation.

III. METHODOLGY

The system aims to automate the evaluation of handwritten assignments by integrating Optical Character Recognition (OCR), Natural Language Processing (NLP), and automated grading logic. The methodology consists of the following key stages:

A. Handwritten Assignment Submission

Students submit scanned images or photos of their handwritten assignments through a web-based interface. Each submission is associated with metadata such as student ID, assignment ID, and subject.

B. Optical Character Recognition (OCR)

The submitted handwritten documents are processed using a cloud-based OCR engine (e.g., Google Vision API) to extract textual content. Advanced OCR models trained on cursive and unconstrained handwriting are employed to improve recognition accuracy. The extracted text is preprocessed through normalization, noise reduction, and segmentation techniques to prepare it for semantic analysis.

C. Preprocessing and Text Cleaning

Post-OCR text is cleaned to remove artifacts, correct spelling errors, and standardize the structure. Tokenization, stopword removal, and lemmatization are applied to ensure that the text is in a form suitable for NLP-based comparison.

D. NLP-Based Answer Evaluation

Each student response is compared with a predefined model answer stored in the database. NLP techniques such as:

- Sentence Embeddings (e.g., BERT, Sentence-BERT)
- Cosine Similarity
- Semantic Matching and Keyword Mapping are applied to evaluate the semantic similarity between student responses and model answers. This enables the system to go beyond superficial keyword matching and assess the actual meaning and context of the answers.

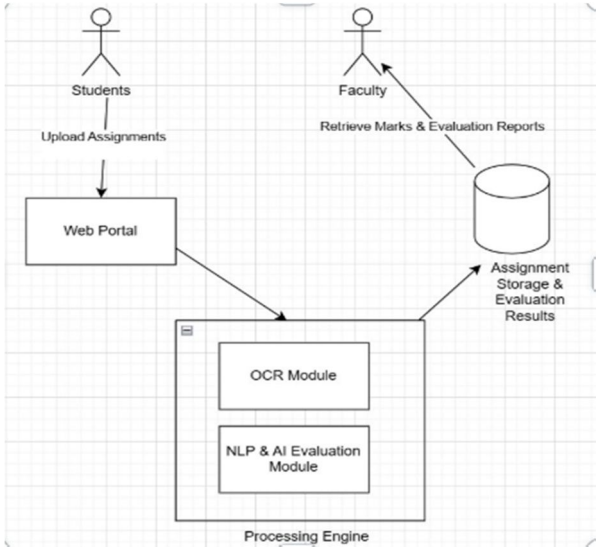


Fig 2 System Architecture

E. Grading and Scoring

The similarity scores generated by the NLP model are mapped to marks using a grading rubric. If the similarity exceeds a predefined threshold (e.g., 80%), full marks are awarded; partial scores are given for intermediate similarity levels. This scoring logic ensures consistency and fairness in evaluation.

F. Result Storage and Retrieval

Final scores, along with evaluation logs and comments (if any), are stored in a structured database. Students and faculty can access these results through a dashboard that allows viewing, downloading, and reviewing performance.

G. Feedback and Continuous Learning

To improve accuracy over time, the system allows manual overrides by faculty members and uses this data to refine grading models through periodic retraining, enabling continuous improvement

IV. RESULTS AND DISCUSSION

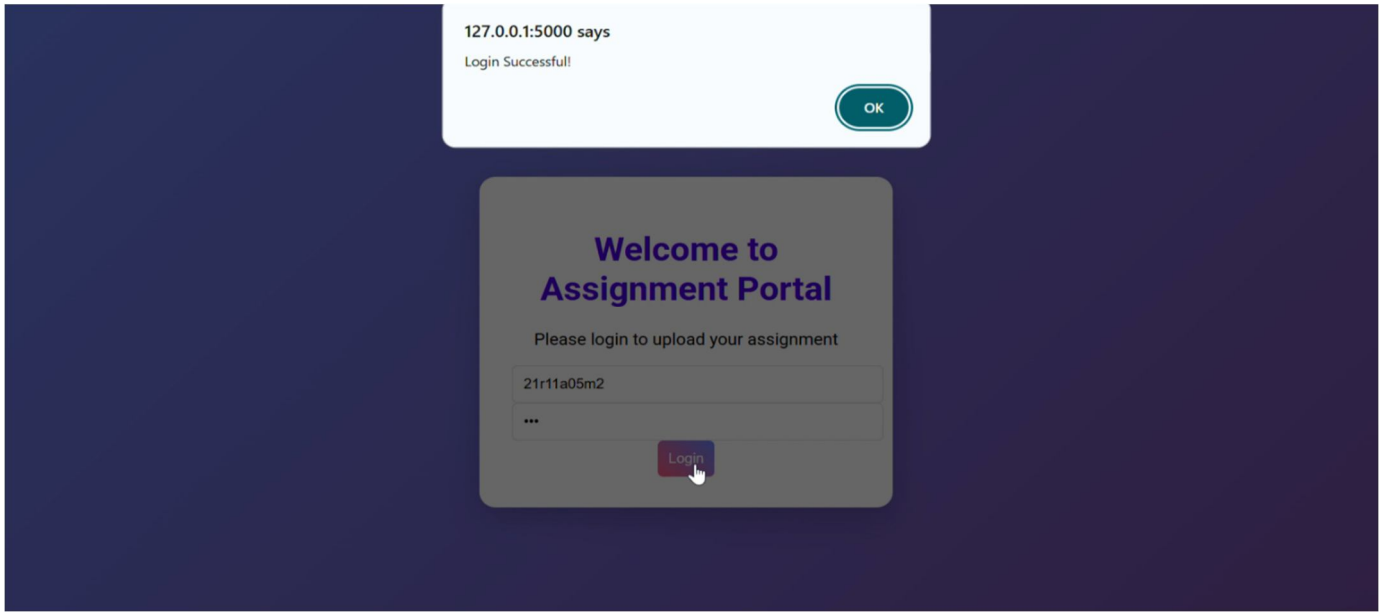


Fig.2 Home screen

The above image is the login screen of the Assignment Upload Portal, where users are prompted to authenticate using their credentials. Upon entering a valid user ID and password, a confirmation message stating "Login Successful!" is displayed, indicating access to the next stage of the system. The interface uses a clean, modern design with a welcoming purple gradient background that enhances the user experience.

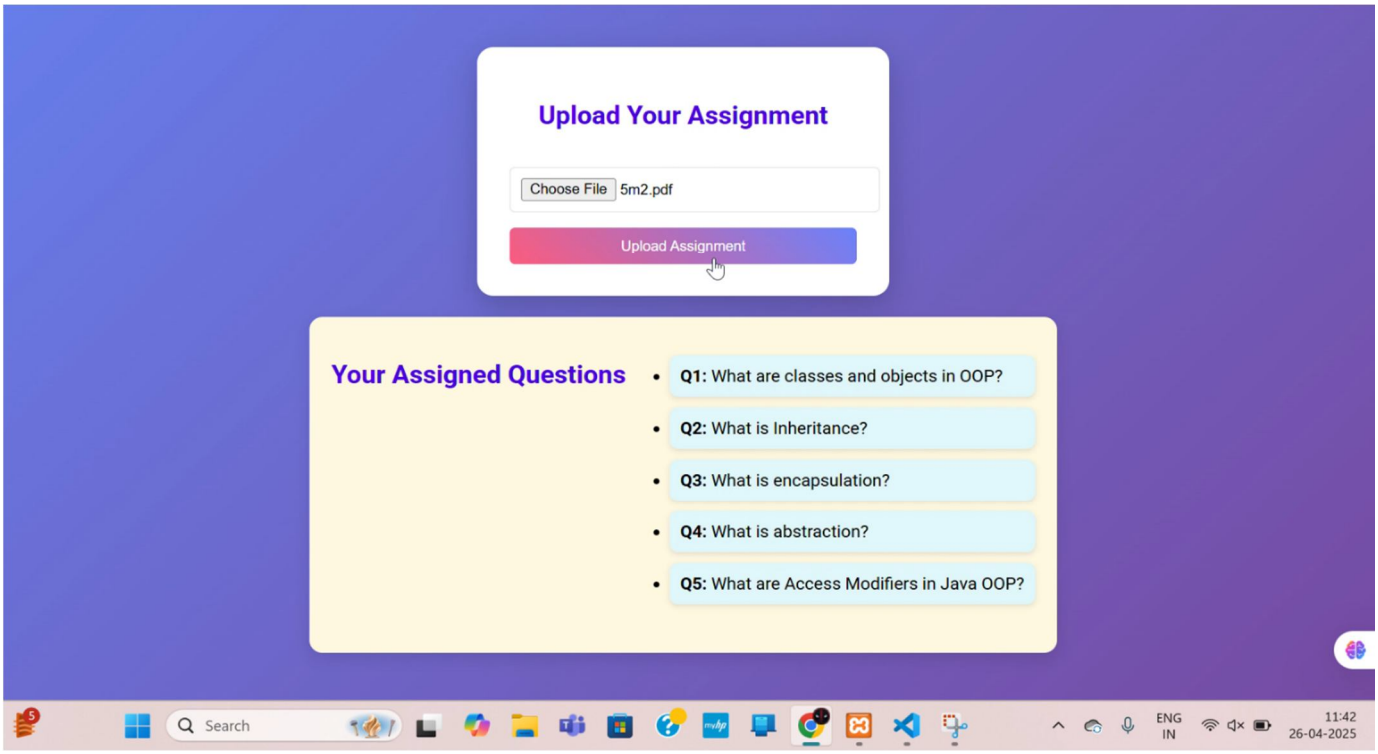


Fig.3 Assignment Upload Screen

The above image demonstrates the file upload interface, where the student selects their assignment file (in this case, "5r0.pdf") for submission. A clearly labeled button, "Upload Assignment," is presented to initiate the upload process. The UI maintains consistency in design, ensuring clarity and ease of use for students submitting their handwritten assignments for evaluation.

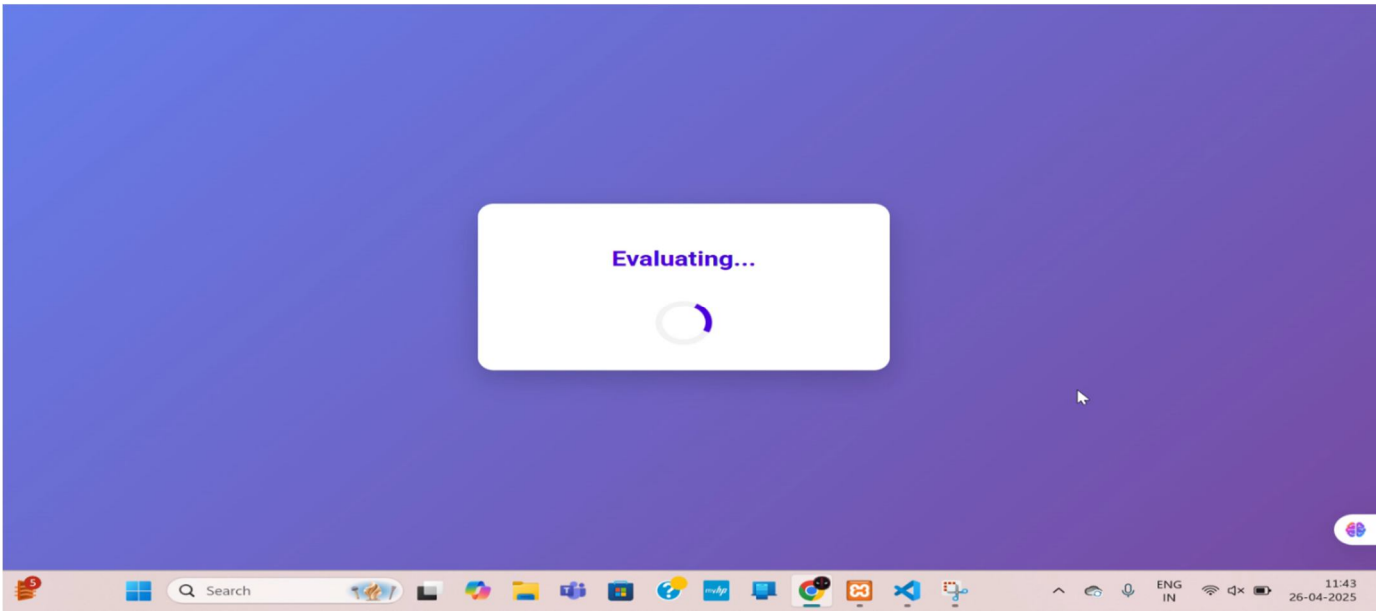


Fig.4 Evaluation Screen

The above image shows the system's transitional stage where the uploaded assignment is being processed. A centered dialog box displays the message “Uploading and Evaluating...” accompanied by a loading animation, signifying that the system is actively working—likely involving tasks such as file validation, OCR, or content analysis through AI modules.

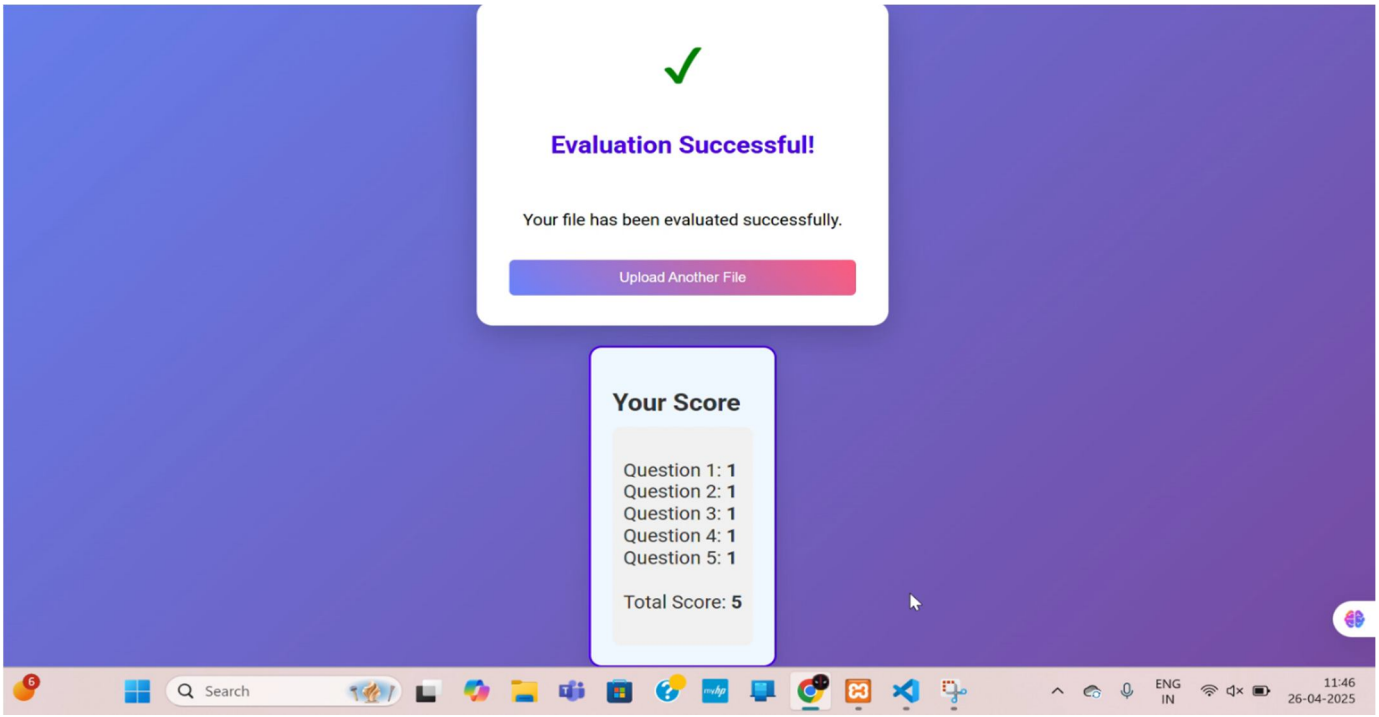
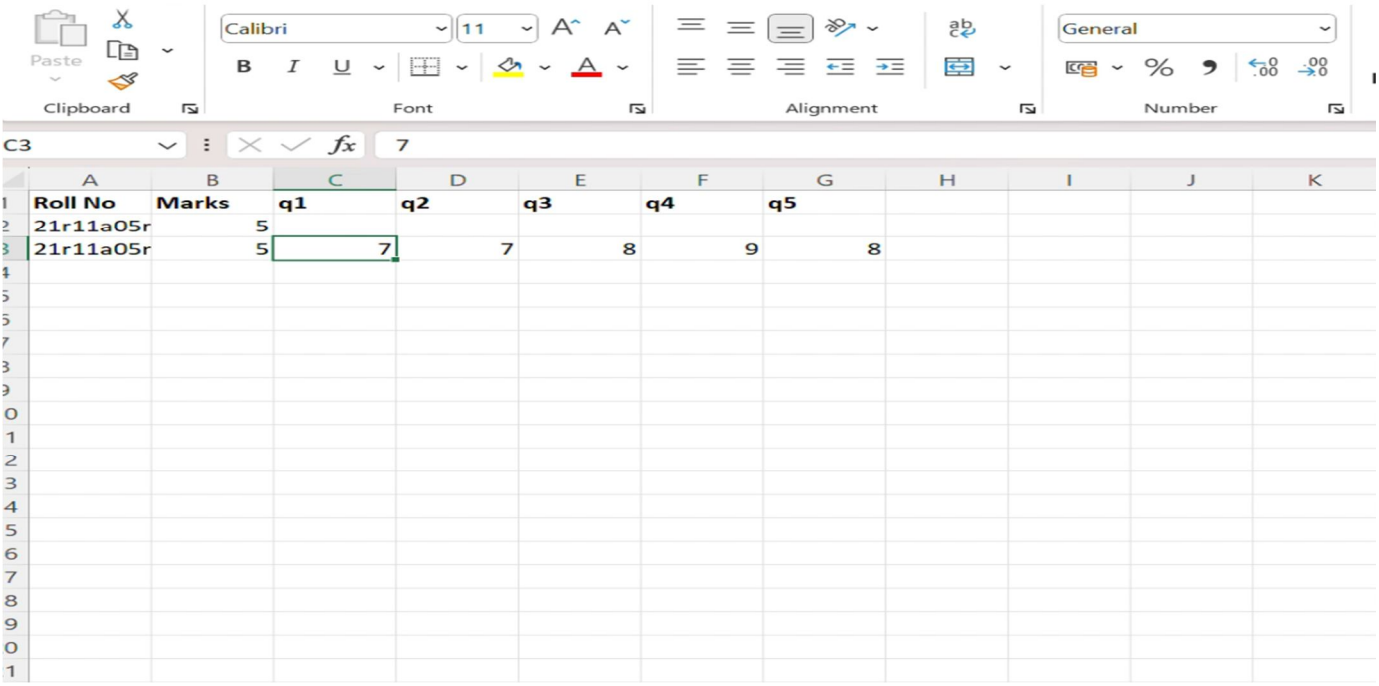


Fig.5 Success

This image confirms the successful upload and evaluation of the assignment with a prominently displayed “Success!” message. It reassures the user that their submission has been processed correctly and offers an option to “Upload Another File,” thereby allowing users to submit multiple assignments without navigating away from the portal.

After successful Evaluation,the marks are stored in the excel sheet which are accessed by faculty.The final marks are also displayed on the dashboard which can be viewed by students.



	A	B	C	D	E	F	G	H	I	J	K
1	Roll No	Marks	q1	q2	q3	q4	q5				
2	21r11a05r	5									
3	21r11a05r	5	7	7	8	9	8				

V. CONCLUSION

The proposed AI-based system for automated evaluation of handwritten assignments effectively integrates Optical Character Recognition (OCR) and Natural Language Processing (NLP) to streamline the academic grading process. By leveraging OCR, the system accurately converts handwritten content into digital text, which is then analyzed using advanced NLP models to evaluate semantic similarity, grammatical structure, and content relevance. This approach not only reduces manual workload and human bias but also ensures faster, consistent, and scalable evaluation across a large volume of assignments. Furthermore, the integration of deep learning techniques enhances the system's ability to handle diverse handwriting styles and complex answer patterns. Overall, this intelligent auto-grading system represents a significant step toward digital transformation in the education sector, offering a reliable and efficient solution for academic institutions aiming to modernize their assessment methodologies.

The AI-based system is designed to be adaptable to various academic disciplines and subjects, enabling it to assess a wide range of assignments. By utilizing a predefined question bank, the system ensures that each student receives unique questions, promoting fairness and preventing cheating. The system's ability to dynamically adjust difficulty levels based on the student's responses further personalizes the assessment, providing a more accurate reflection of their knowledge and capabilities.

Additionally, the system can continuously learn and improve its grading accuracy over time by incorporating feedback and fine-tuning the NLP models, enhancing its performance as more data is processed.

The system's use of Natural Language Processing also ensures that the evaluation is context-aware and can detect rephrased answers, paraphrased content, or subtle differences in meaning, all of which are commonly encountered in academic assignments. It goes beyond simple keyword matching, enabling a deeper understanding of the student's thought process and reasoning. This approach not only results in more accurate and fair grading but also provides valuable insights into areas where students may need further improvement or clarification. As such, the system becomes a powerful tool for both grading and educational development.

In addition to automating the grading process, the system also streamlines administrative tasks such as report generation and feedback distribution. Once the evaluation is complete, the results are automatically compiled into an easy-to-read format, which is then shared with faculty for review or directly with students. This eliminates the need for time-consuming manual entry of grades and feedback, reducing the administrative burden on educators and allowing them to focus more on teaching and student support.

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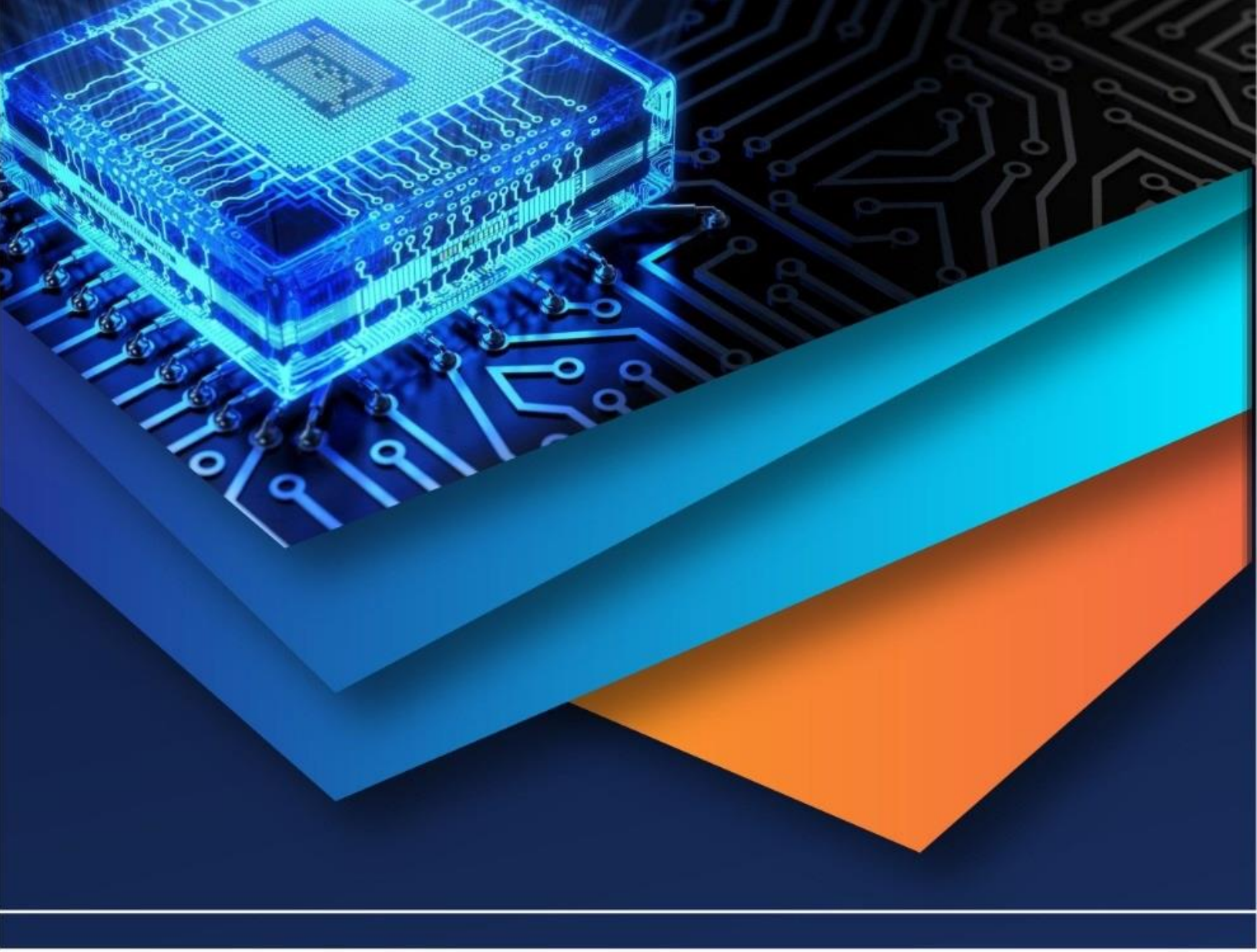

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