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AI-Driven OCR-Based Script Grading

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Abstract: ***AI-Driven OCR-Based Script Grading System is a novel web-based solution designed to automate the evaluation of descriptive answers in educational assessments, addressing significant challenges associated with manual grading processes, such as inconsistent scoring and high time consumption. This system integrates cutting-edge technologies like Optical Character Recognition (OCR), Natural Language Processing (NLP), and advanced summarization techniques to streamline answer script evaluations effectively. EasyOCR is utilized to accurately extract textual content from scanned handwritten or printed student submissions. Subsequently, this extracted text undergoes summarization using the Hugging Face BART model to retain essential points and remove verbosity, facilitating precise comparative analysis. The summarized student responses are compared against predefined teacher answers through SequenceMatcher, calculating a semantic similarity score. This similarity score directly translates into objective grading, significantly reducing educator workload and eliminating potential grading biases. The Flask-based web platform provides a secure, intuitive, and efficient interface for educators, ensuring seamless integration into existing educational workflows. This automated grading system promotes consistency, enhances accuracy, and markedly improves turnaround times, ultimately enabling educators to dedicate greater attention toward instructional quality and student engagement.***

I. INTRODUCTION

The process of evaluating descriptive answer scripts in educational institutions is traditionally a labor-intensive and time-consuming task, often leading to inconsistencies due to subjective assessments. With increasing student populations and a growing emphasis on timely, accurate feedback, manual grading places significant pressure on educators, diverting valuable time away from core teaching activities. Furthermore, manual evaluation processes are prone to human error, bias, and fatigue, which can adversely affect the fairness and reliability of student assessments.

Addressing these critical challenges, this paper introduces an innovative **AI-Driven OCR-Based Script Grading System** designed to automate and streamline the evaluation process of descriptive answers. By integrating sophisticated Artificial Intelligence (AI) methods, particularly Optical Character Recognition (OCR) and Natural Language Processing (NLP), the system efficiently extracts and analyzes textual data from student answer scripts. EasyOCR technology is employed for precise text extraction from images of handwritten or printed responses. Subsequently, the Hugging Face BART summarization model condenses the extracted text, ensuring relevant content remains while extraneous details are minimized.

To objectively evaluate student responses, the system leverages SequenceMatcher, a semantic similarity calculation algorithm, comparing summarized student answers to teacher-provided model answers. This semantic comparison yields similarity scores, ensuring a standardized and objective grading methodology free from subjective biases inherent in manual grading. Moreover, the automated system significantly reduces the time required for evaluation, enabling educators to promptly deliver accurate feedback.

Built upon a robust Flask-based web framework, the platform ensures user-friendly, secure, and scalable interaction, making it easily adoptable by educational institutions. By automating repetitive administrative tasks associated with grading, educators can refocus their efforts on enhancing instructional quality and student engagement. Ultimately, this AI-driven system aims to transform educational assessments, providing accuracy, efficiency, and fairness in grading practices.

II. OBJECTIVES

The AI-Driven OCR-Based Script Grading System aims to achieve the following primary objectives:

1) *Automate and Accelerate Grading Process:* Significantly reduce the time educators spend manually grading descriptive answer scripts by providing automated, rapid evaluations through AI techniques.
2) *Enhance Accuracy and Consistency:* Leverage Optical Character Recognition (OCR) and Natural Language Processing (NLP) technologies to minimize human error and subjective biases, ensuring that each student's responses are evaluated fairly and consistently.

3) *Support Multiple Input Formats:* Effectively handle diverse submission formats, including handwritten scripts and printed documents, providing flexibility and convenience to students and educators.
4) *Facilitate Customizable Evaluation Criteria:* Enable teachers to define and customize evaluation standards easily, such as marking schemes and scoring thresholds, adapting the system to different educational requirements.
5) *Generate Comprehensive Analytical Reports:* Provide insightful, detailed reports on student performance through CSV exports, helping educators quickly identify student strengths, weaknesses, and overall academic trends for informed decision-making.

These objectives collectively aim to enhance overall teaching efficiency, improve grading reliability, and ensure timely feedback, thereby significantly enriching the educational assessment process.

III. RELATED WORKS

Literature Survey

1) Smart Grading – Generative AI for Answer Evaluation (2024):

Tobler introduces a generative AI-based grading tool to automate evaluations of descriptive answer scripts. This web-based application employs generative models like ChatGPT, enabling educators to input questions, model answers, and custom grading criteria for consistent scoring. Experimental results show high agreement between the AI system and human expert assessments, highlighting its reliability. A major advantage is the significant reduction in manual grading effort, particularly for large batches of scripts. However, the approach faces challenges with complex or multi-part questions, as the AI occasionally struggles with accurately interpreting nuanced or multipart responses. Despite this limitation, the approach demonstrates considerable potential for automating descriptive answer evaluations.

2) "Eval" – Automated Answer Script Evaluation using OCR and NLP (2023):

Prerana M. S. et al. present a framework integrating OCR and NLP to automate answer script grading. Their methodology leverages Google Cloud OCR for digitizing handwritten texts, followed by keyword extraction using BERT and summarization via GPT-3. The generated summaries and extracted keywords are compared against teacher-provided model answers to assign scores. This solution is implemented as a web-based system, significantly automating the grading process. The framework effectively reduces teacher workload and matches the accuracy of human graders. However, it relies heavily on specific keyword matches, potentially missing correct answers phrased differently. This limitation underscores the importance of semantic understanding for robust evaluations.

3) Automated MCQ Grading with Tesseract OCR and YOLOv8 (2024):

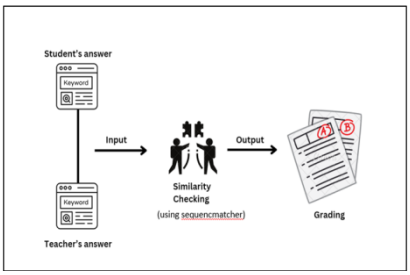
Mahmud et al. propose a system combining computer vision and OCR technologies to automate grading multiple-choice exams. The system utilizes the YOLOv8 object detection model to identify marked answer options on scanned sheets, complemented by Tesseract OCR for reading question numbers. Answers are then matched automatically against an answer key, achieving high accuracy with an F1 score of 0.98 and a mean Average Precision of 0.99. A significant strength of their solution is its independence from specialized answer templates, making it highly adaptable. Although limited to MCQ grading, this research demonstrates the potential for OCR-based solutions to enhance grading efficiency, complementing systems aimed at descriptive answers.

4) Handwritten Text Recognition with EasyOCR(2023):

Pattanayak et al. developed a robust method for offline handwritten text recognition utilizing EasyOCR, a PyTorch-based OCR library. The system segments scanned handwritten documents into character regions, recognizing them individually using convolutional neural networks (CNN). This technique achieves an accuracy rate exceeding 90% for English handwriting recognition. Its adaptability to various handwriting styles and compatibility with low-power devices like Raspberry Pi highlight its versatility. However, performance can degrade due to variations in handwriting quality, lighting, and image conditions, indicating areas for improvement. This research validates EasyOCR's applicability for accurately digitizing handwritten scripts, a crucial component of automated grading solutions.

IV. PROPOSED METHOD

The proposed AI-Driven OCR-Based Script Grading System aims to revolutionize the evaluation of descriptive answers in educational assessments. This system combines advanced artificial intelligence technologies, primarily Optical Character Recognition (OCR) and Natural Language Processing (NLP), to automate and enhance the grading process effectively.



A. Architecture

The architecture of the AI-Driven OCR-Based Script Grading System is designed to automate and streamline the evaluation of descriptive answers using OCR and NLP technologies. The system follows a modular pipeline as outlined below:

1) *Data Input and Preprocessing:* Teachers and students upload scanned images or photographs of answer scripts through a web-based interface. Preprocessing techniques such as resizing, contrast adjustment, and noise removal are applied to enhance text readability.
2) *Text Extraction using OCR:* The system utilizes EasyOCR, a deep learning-based optical character recognition engine, to convert the visual content from handwritten or printed scripts into editable digital text.
3) *Text Summarization using NLP:* Extracted text is processed through the BART summarization model from Hugging Face to generate concise summaries. This step focuses on retaining key points for more meaningful comparison and evaluation.
4) *Similarity Calculation and Scoring:* Summarized student responses are compared with model answers provided by teachers using SequenceMatcher from Python's difflib. A similarity percentage is calculated, which forms the basis for marks allocation.
5) *Grading Formula:* Marks are assigned using the formula:
   Marks Awarded=(Similarity Percentage100)×Total Marks\text{Marks Awarded} = \left(\frac{\text{Similarity Percentage}}{100}\right) \times \text{Total Marks}Marks Awarded=(100Similarity Percentage)×Total Marks
6) *CSV Report Generation:* The system compiles a detailed CSV report containing USN, question numbers, marks obtained, and similarity scores for each student, which teachers can download for record-keeping.

B. Workflow

The process begins when the teacher provides the number of questions, uploads model responses, and assigns marks. These inputs are sent to the AI-driven system, which handles core operations such as text extraction, summarization, and semantic similarity checking between student answers and model answers.

Once processed, the results are stored in the file storage module and a summary is generated. The final output, including evaluated marks and similarity percentages, is sent back to the teacher for review or download.

This diagram captures the high-level interaction flow, illustrating the system's streamlined architecture for automated and efficient grading.

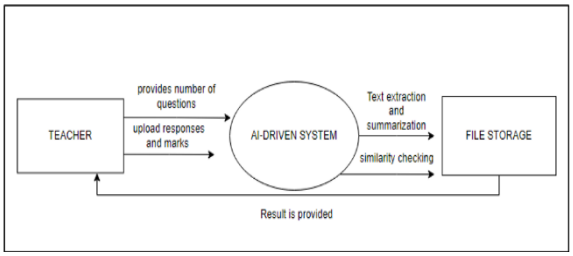


Figure1 Zero LevelDataflowdiagram

C. SequenceModels

Sequence models represent the order of interactions between system components over time. In the context of UML, these dynamic diagrams illustrate how objects communicate to complete specific functions, using lifelines and messages to indicate the flow of control and data.

For the AI-Driven OCR-Based Script Grading System, the sequence model outlines the key interactions during the evaluation process. The teacher initiates the system by logging in, setting up the number of questions, and uploading both model answers and student scripts.

The system then performs text extraction using the OCR module, followed by summarization and semantic analysis via the NLP module. Similarity scores are calculated, marks are assigned, and the final results are presented to the teacher.
This model ensures a clear, structured interaction between user and system, validating automation, and maintaining consistency throughout the grading workflow.

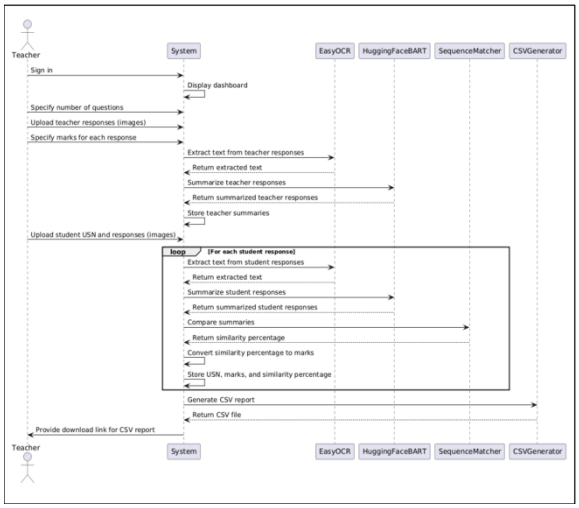


Figure2TeacherSequence Models

D. Use Case Diagram

The use case diagram illustrates the interaction between the teacher and the Automated Answer Paper Evaluation System. The teacher is the primary actor who performs key functions within the system. These include:

1) Upload Teacher Script: The teacher uploads the model answers or key for evaluation.
2) Input Total Marks: The teacher specifies the total marks for each question.
3) Upload Student Scripts: Student answer scripts (handwritten or typed) are uploaded for evaluation.
4) View Report: After processing, the teacher can view the results of the evaluation.
5) Download Summary CSV: The system generates a summary report containing scores and similarity percentages, which the teacher can download as a CSV file.

The system boundary encapsulates all these use cases, ensuring a streamlined.

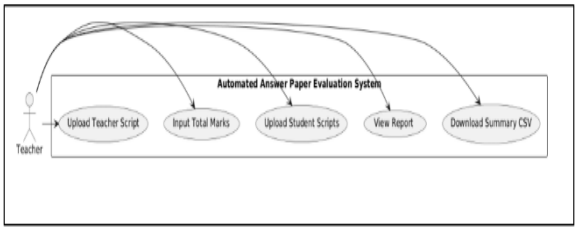


Figure3UML(UnifiedModelingLanguage)

V. RESULTS AND DISCUSSION

The system was thoroughly tested through real-time interaction and sample answer scripts to validate its accuracy, usability, and automation capabilities. Results confirmed that the AI-Driven OCR-Based Script Grading System meets its core objectives of efficient and objective evaluation of descriptive answers.

1) Interface Usability and Functionality:

The user interface was tested for both teacher and student modules:

- As shown in *Figure 4*, teachers can upload the number of questions, assign marks, and upload corresponding model answers in image format.
- In *Figure 4*, the student interface enables submission of handwritten answers per question and entry of the student's USN. This step-by-step workflow simplifies the interaction and reduces human error during script uploading.

2) Automated Evaluation and Accuracy:

Once scripts are submitted:

- The system extracts text using EasyOCR.
- Summarizes both teacher andstudent answers using the BART model.
- Compares responses usingSequenceMatcher to compute a similarity score.

This automated pipeline provides consistent results even with variations in handwriting or formatting, minimizing grading bias and increasing reliability.

3) Output Generation and Performance:

As illustrated in *Figure 4* and *Figure 5*, the system successfully evaluates and generates a detailed CSV report:

- Figure 5 show how results are presented in a structured format, listing the USN, question number, similarity percentage, and marks awarded.
- In the shown sample, the student achieved 100% similarity in both responses, leading to full marks being assigned accordingly.

4) Robustness Across Inputs:

The system was evaluated with both typed and handwritten scripts. It handled common challenges such as:

- Low-resolution images
- Light noise in scanned documents
- Different handwriting styles

5) Time Efficiency and Automation:

The complete evaluation.

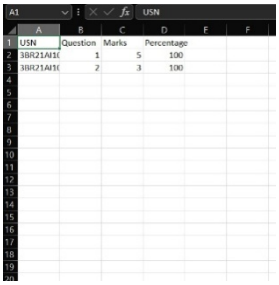


Figure4 Results

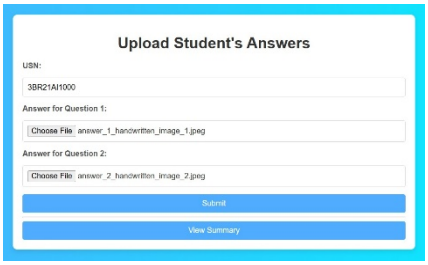


Figure5 Results

VI. ACKNOWLEDGMENT

We extend our sincere gratitude to all those who supported and guided us throughout the successful completion of this project, AI-Driven OCR-Based Script Grading System.

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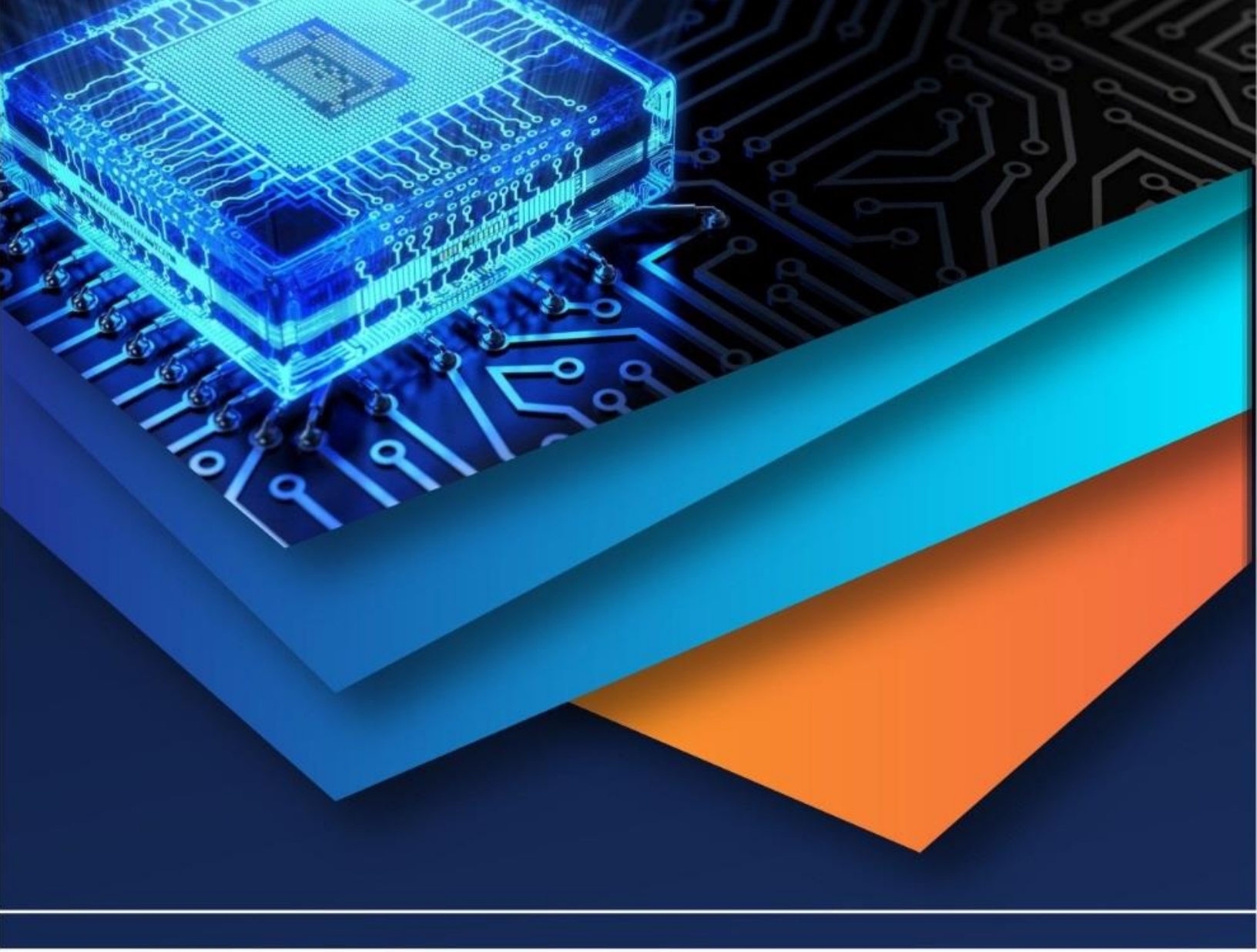

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