

AI-Based Handwritten Answer Evaluation System

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Abstract: The AI-Based Handwritten Answer Evaluation System is a web-based application designed to assist teachers in evaluating handwritten examination answers. The system provides a platform for teachers to create classes, prepare tests, add questions, and define reference answers. Students can upload handwritten answer sheets in image or PDF format for automated processing. An AI-enabled Optical Character Recognition (OCR) service is used to extract handwritten text from the uploaded documents. The extracted responses are organized question-wise and compared with teacher-provided reference answers using semantic similarity, keyword overlap, and fuzzy text matching techniques. Based on the implemented scoring logic, the system generates preliminary question-wise marks and calculates the overall score. Python and Flask support the web application, while MySQL and SQLAlchemy manage assessment records and evaluation results. Teachers can review the extracted responses and suggested marks, make corrections, and finalize the results. The system aims to support assessment workflows by reducing repetitive evaluation tasks and organizing student performance records. However, the reliability of the generated marks depends on handwriting recognition quality, reference-answer accuracy, and the scoring logic. Teacher supervision remains necessary before finalizing assessment results. Further testing using diverse handwriting samples and teacher-verified scores is required to evaluate the system's accuracy and reliability.

Keywords: Handwritten Text Recognition, Optical Character Recognition, Natural Language Processing, Answer Evaluation, Image processing.

I. INTRODUCTION

Evaluating handwritten examination answers is a time-consuming task in educational institutions. Teachers must read each response, compare it with the expected answer or marking scheme, assign marks, and maintain assessment records. The process becomes more demanding when a large number of students submit answer sheets. Manual evaluation also requires consistency and careful consideration of answers that express the same concept using different wording. Therefore, an automated tool that assists teachers in repetitive evaluation tasks can help organize the assessment process.

The proposed AI-Based Handwritten Answer Evaluation System is a web-based application developed using Python and Flask to support the evaluation of handwritten answers. Teachers can create classes, prepare tests, enter questions and reference answers, and publish assessments for students. Students can upload their handwritten answer sheets in image or PDF format. An AI-enabled Optical Character Recognition (OCR) service, accessed through the Open Router API, extracts the handwritten text and helps organize responses according to individual questions [5]. The extracted answers are compared with teacher-provided reference answers using semantic similarity, keyword overlap, and fuzzy text matching [7]. Based on the implemented scoring logic, the system generates preliminary question-wise marks and calculates the total score. MySQL and SQLAlchemy are used to manage assessment and evaluation records. Teachers can review the extracted text, modify the suggested marks, and finalize the results.

The main objective of the proposed system is to reduce repetitive evaluation work and provide an organized digital assessment workflow while maintaining teacher supervision. Since OCR errors, unclear handwriting, and variations in answer wording may affect the generated scores, the system is intended to assist rather than replace teachers. The proposed approach integrates handwritten text extraction, reference-based answer comparison, score generation, and teacher-assisted evaluation within a single application.

Furthermore, the system maintains assessment information in a centralised database, enabling teachers to access evaluation records and review student performance. The use of multiple text-comparison techniques helps assess responses from different perspectives rather than relying only on exact keyword matching. The question-wise evaluation process also helps teachers identify the marks assigned to individual answers and make corrections when necessary. However, the reliability of the generated scores must be examined through testing with different handwriting styles and answer variations. The system's performance can be further improved by refining the text extraction process and scoring methods. This approach provides a foundation for developing more efficient digital assessment tools for educational institutions.

II. MATERIALS AND METHODS

The proposed system follows a sequence of steps, beginning with answer-sheet upload and ending with teacher-reviewed evaluation.

Answer Sheet Upload:

The user uploads a handwritten answer sheet in image or PDF format through the web interface. The uploaded document serves as the input for text extraction and subsequent evaluation.

Image and Document Processing:

The uploaded file is prepared for OCR processing. For PDF documents, the pages are processed so that their handwritten content can be analyzed. Appropriate preprocessing helps organize the input for text recognition.

Handwritten Text Recognition:

An AI-enabled OCR service accessed through Open Router is used to extract text from the uploaded answer sheet. The extracted text is processed to identify student responses and prepare them for comparison with the reference answers. Recognition quality may vary depending on handwriting clarity, image quality, and document layout.

Answer Parsing:

The extracted text is organized into individual answers associated with their respective questions wherever the document structure permits. This step helps the system compare each student response with the corresponding teacher-provided reference answer.

Answer Evaluation:

The system uses three complementary comparison methods:

Semantic Similarity: Estimates the similarity in meaning between the student's response and the reference answer, allowing differently worded answers to be considered.

Keyword Overlap: Examines the presence of important terms and concepts from the reference answer in the extracted response.

Fuzzy Text Matching: Identifies approximate textual matches despite minor differences in wording or spelling.

The comparison results are used to generate preliminary marks according to the implemented evaluation logic. The methods support automated assessment, but the suggested marks may require teacher review, particularly for ambiguous or incorrectly recognized text.

Score Storage and Teacher Review:

The preliminary marks and relevant evaluation information are stored in a MySQL database. Teachers can review the extracted responses and suggested scores, make necessary adjustments, and finalize the evaluation. This step provides human supervision over the automated assessment process.

Materials and Technologies Used

The proposed system is developed using Python and Flask to provide a web-based interface for handwritten answer evaluation [1], [2]. An AI-enabled Optical Character Recognition (OCR) service accessed through Open Router is used to extract text from uploaded handwritten answer sheets. MySQL is used for data storage, while SQLAlchemy manages database operations [3], [4]. The system accepts handwritten answer sheets in image or PDF format and uses teacher-provided reference answers for evaluation.

Methodology

1. **Input Collection:** Handwritten answer sheets are uploaded in image or PDF format, along with the corresponding reference answers provided by the teacher.
2. **Text Extraction:** The OCR service extracts handwritten content from the uploaded documents and converts it into digital text [5].
3. **Answer Processing:** The extracted text is organized into student answers for comparison with the corresponding reference answers.
4. **Answer Evaluation:** The system compares student answers with reference answers using semantic similarity, keyword overlap, and fuzzy text matching techniques to estimate answer relevance.
5. **Score Generation:** Preliminary marks are generated based on the implemented evaluation logic.
6. **Result Storage and Review:** Evaluation-related information is stored in the MySQL database. The teacher reviews the generated marks and can make corrections before finalizing the results.

III. SYSTEM ARCHITECTURE

The proposed system consists of an input module, OCR module, evaluation module, teacher review module, and database layer. The input module accepts handwritten answer sheets and reference answers. The OCR module extracts

handwritten text, while the evaluation module compares the extracted answers with the reference answers and generates preliminary marks. Flask coordinates the application workflow, and MySQL with SQLAlchemy manages the storage of evaluation-related information. The teacher reviews and finalizes the generated marks.

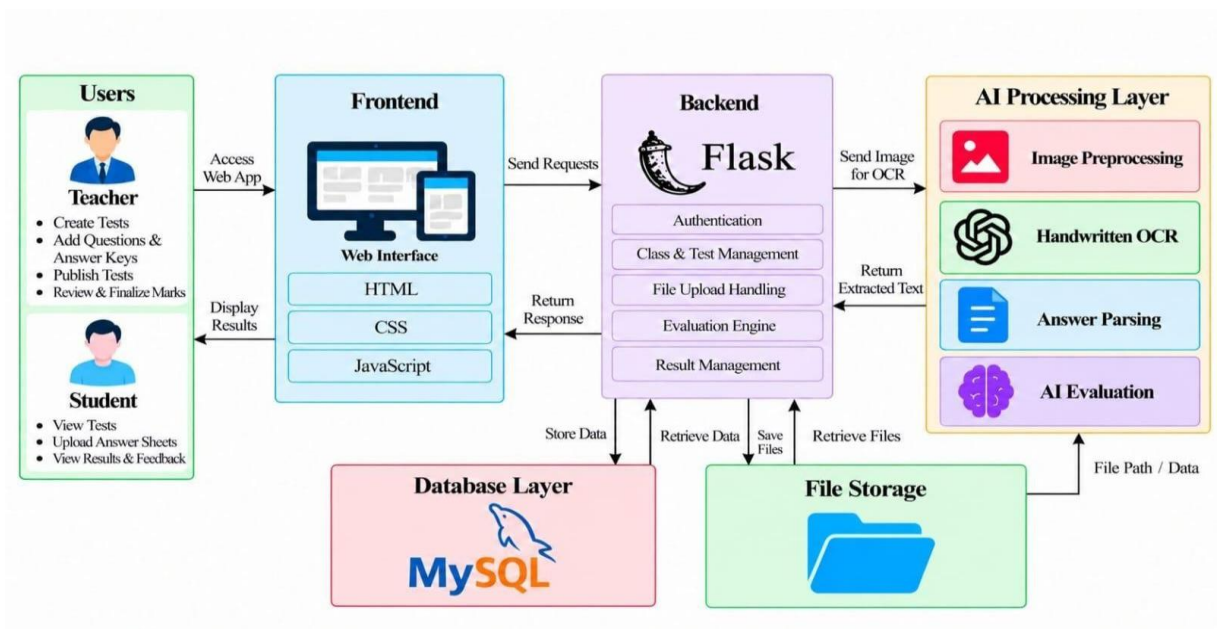


Fig.1 System Architecture of Answer Evaluation System

IV. RESULT AND DISCUSSION

The AI-Based Handwritten Answer Evaluation System is designed to automate the evaluation of handwritten answers using Artificial Intelligence (AI) and Optical Character Recognition (OCR). The system allows teachers to create tests, add questions and answer keys, and publish tests for students.

Students can upload their handwritten answer sheets in image or PDF format. The system processes the uploaded documents, extracts handwritten text, and organizes the answers question-wise. It then compares the extracted answers with the teacher's key answers using semantic similarity, keyword matching, and fuzzy text comparison to generate preliminary marks.

The results are stored in the database and displayed to the users through their respective dashboards. Teachers can review and modify the generated marks before finalizing the results. The results demonstrate how the system can reduce manual effort, save time, and make the evaluation process more organized and efficient. The system integrates text extraction, answer comparison, score generation, and result management into a single workflow. The dashboard provides a convenient way to access assessment information and view evaluation outcomes. Furthermore, maintaining records in the database supports the organized storage and retrieval of student evaluation details.

However, variations in handwriting and differences between student responses and reference answers may influence the generated scores. Errors during text extraction can also affect the final evaluation. Therefore, teacher verification remains essential to ensure that marks are appropriate. Further testing using diverse handwritten answer sheets and teacher-assigned scores would help assess the reliability and effectiveness of the proposed system.

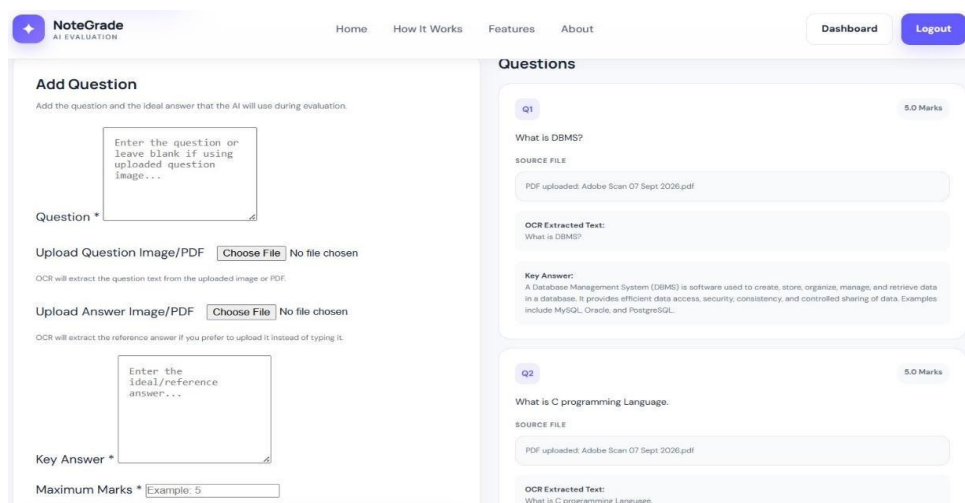


Fig. 2. Question and reference-answer interface

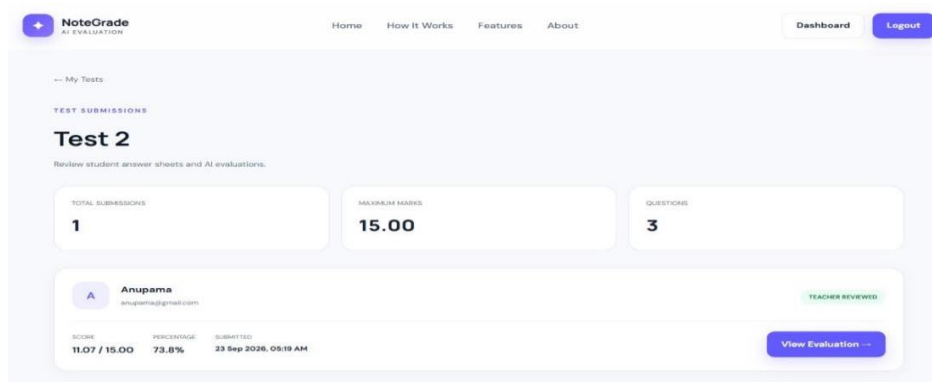


Fig. 3. Test Submission dashboard showing student evaluation results

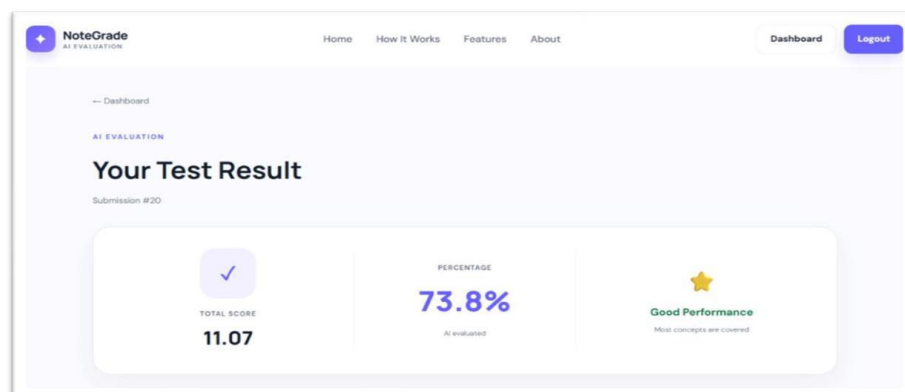


Fig. 4. Evaluation Results Generated by the Proposed AI-Based Handwritten Answer Evaluation System

The evaluation results demonstrate the system's ability to generate a preliminary score and corresponding performance feedback for a student submission. The generated results are intended to assist teachers in assessing student answers.

However, the reliability of the evaluation depends on OCR accuracy, the quality of the reference answers, and the implemented scoring logic.

V. CONCLUSION

The proposed AI-Based Handwritten Answer Evaluation System provides an automated approach to extracting handwritten text and evaluating student answers using OCR and text comparison techniques. By combining semantic similarity, keyword overlap, and fuzzy text matching, the system generates preliminary marks based on teacher-provided reference answers. The integration of Flask, MySQL, and SQLAlchemy supports the management of evaluation-related information. The system can help reduce repetitive evaluation work and support teachers in the assessment process. However, the quality of evaluation depends on OCR accuracy and the implemented scoring logic. Teacher review remains essential before finalizing marks. Future improvements may focus on enhancing handwriting recognition, refining scoring techniques, and evaluating system performance using larger datasets.

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