

AUTOMATED SUBJECTIVE HANDWRITTEN ANSWER EVALUATION SYSTEM

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Abstract - The evaluation of handwritten subjective answers is a time-consuming and subjective process prone to inconsistencies and human bias. This paper introduces an Automated Subjective Handwritten Answer Evaluation System that utilizes Artificial Intelligence to enhance grading efficiency and precision. The suggested system uses Optical Character Recognition (OCR) to turn handwritten text into digital format and Bidirectional Encoder Representations from Transformers (BERT) to analyse the meaning of the text. The system compares student answers to pre-defined model answers to see how similar, relevant, and complete they are in context. The results of the experiment show that the new method is more consistent and takes less time to grade than the old method. The system can be used in large educational settings because it is scalable, gives quick feedback, and needs less human input. This method makes subjective answer evaluation much more fair, accurate, and efficient.

Key Words: OCR, NLP, BERT, Handwriting Recognition, Automated Evaluation, Machine Learning.

1. INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) has enabled automation in various domains, including education. Evaluating handwritten subjective answers in the usual way takes a lot of work, time, and is often affected by human bias and inconsistency. As the number of students grows and the need for faster result processing rises, an automated and dependable evaluation system is needed.

This paper suggests an Automated Subjective Handwritten Answer Evaluation System that uses Optical Character Recognition (OCR), Natural Language Processing (NLP), and Machine Learning (ML) together. The system changes handwritten answers into digital text and then uses semantic understanding to grade them. The system uses advanced models like BERT to make sure that it understands the meaning of the context correctly instead of just matching keywords.

The proposed solution aims to improve grading efficiency, ensure fairness, and provide instant feedback

to students, making it suitable for modern educational systems.

2. RELATED WORK

Several research works have been conducted in the field of automated answer evaluation. Existing systems primarily rely on keyword matching, machine learning, and deep learning approaches.

Singh and Shah suggested a mobile-based system that uses NLP methods like Word2Vec and similarity measures to check handwritten answers. Rahaman and Mahmud proposed a deep learning methodology employing Convolutional Neural Networks (CNN) for handwriting recognition. Pawar et al. combined OCR with deep learning for automated evaluation. This made things more efficient, but OCR accuracy was still a problem.

Other methods include semantic learning-based systems that focus on understanding the context instead of matching words exactly. Combining OCR, NLP, and language models into multi-modal approaches has improved performance, but they need a lot of computing power.

This work aims to address the ongoing challenges of dealing with different handwriting styles, understanding context, and improving computational efficiency, even though there have been improvements.

3. PROPOSED SYSTEM

The suggested system is meant to make it easier to evaluate handwritten subjective answers by using a two-phase process:

3.1 HANDWRITTEN TEXT EXTRACTION

The first phase consists in uploading scanned images of handwritten answer sheets. We use OCR technology to convert the handwritten text into a format that can be read by the computer. Preprocessing steps such as noise removal, image enhancement, segmentation, etc. improve the accuracy of recognition.

3.2 SEMANTIC ANSWER EVALUATION

In the second phase, the acquired text is submitted to BERT to be analysed for semantic comprehension. The system compares student answers with model answers based on what is called contextual similarity, rather than on the exact words used. A scoring mechanism scores the answers based on relevance, correctness and completeness.

3.3 SYSTEM MODULES

The system consists of the following modules:

- User Authentication Module
- File Upload Module
- Text Extraction Module
- Semantic Analysis Module
- Result Generation Module
- Database Management Module
- Admin Control Module

3.4 ADVANTAGES

- Reduces manual grading effort
- Ensures consistency and fairness
- Provides instant feedback
- Handles large-scale evaluations efficiently
- Minimizes human errors

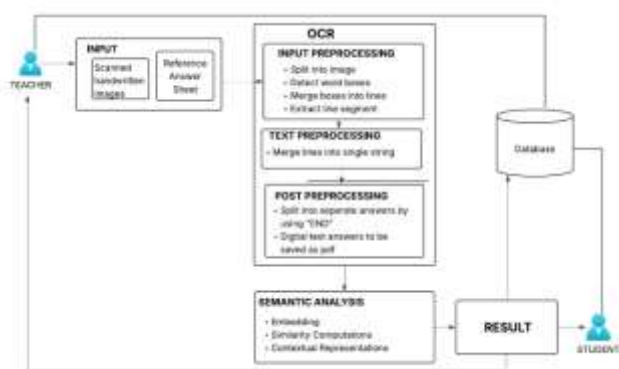


Fig.1. System architecture of the proposed handwritten answer evaluation system

4. SYSTEM IMPLEMENTATION

The system is developed with modern web technologies and AI frameworks. The frontend is powered by React/Next.js, giving an interactive user interface. The backend is developed with the help of Django/NestJS for server-side operations.

BERT is used by the NLP module for the semantic evaluation and the OCR module handles the handwritten inputs. A database system (SQLite / MySQL / PostgreSQL) is used to store user data, answers and results.

The system workflow includes:

1. Uploading answer sheets
2. Converting handwritten text to digital text
3. Analyzing content using BERT
4. Comparing with model answers
5. Generating scores and feedback

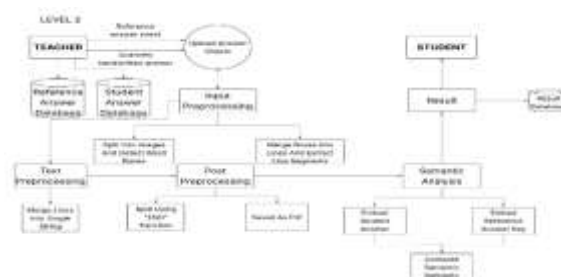


Fig.2.Data flow diagram of answer evaluation workflow

5. RESULTS AND IMPLEMENTATION

The system is more efficient than manual evaluation methods. It greatly reduces the time it takes to grade and ensures consistent scoring.

The evaluation accuracy depends on the OCR performance and the effectiveness of the semantic model. BERT is used to improve the contextual understanding to get better subjective answer evaluation. However, there are still challenges in dealing with complex handwriting styles and highly creative answers. These limitations can be improved in future enhancements.

6.CONCLUSIONS

The paper describes an AI based Automated Subjective Handwritten Answer Evaluation System that employs OCR and NLP techniques to achieve efficient grading. The system improves the accuracy, consistency, and scalability of subjective answer assessment.

The system leverages BERT for semantic understanding to overcome the limitations of traditional keyword-based methods. This reduces the manual effort and gives an instant feedback and is very useful for educational institutions.

Future work will be devoted to improving OCR accuracy, supporting multiple languages and improving the explainability of evaluation results.

ACKNOWLEDGEMENT

The authors are grateful to the Department of Computer Science and Engineering, College of Engineering Kidangoor for their guidance and support throughout the project. I am thankful to the Project Guide for his valuable suggestions and constant encouragement.

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