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Automated Paper Evaluator

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A B S T R A C T

The evaluation of handwritten answer sheets has traditionally been a manual, time-consuming, and error-prone process. With the growing demand for efficiency and accuracy in academic assessments, there is a need for intelligent systems that can assist educators in evaluating student responses effectively. This paper presents an Automated Paper Evaluator, a modern web-based solution designed to evaluate handwritten answers using Optical Character Recognition (OCR) integrated with advanced AI models. The system allows educators to upload predefined question sets along with expected keywords or key concepts. Students' handwritten answers are then scanned, processed, and analyzed to identify relevant content by matching recognized text against the key answers. The model is equipped to handle common OCR inaccuracies and variations in student expression, offering a flexible evaluation approach. Developed using a robust tech stack including Next.js, React, TypeScript, Firebase, and integrated Google Gemini AI via Genkit, this system ensures scalable, real-time evaluation with user-friendly interaction. By automating repetitive tasks and reducing human bias, the tool not only streamlines the evaluation process but also enhances transparency and feedback quality in education.

Keywords: Automated Evaluation, Handwritten Answer Sheets, Optical Character Recognition (OCR), Artificial Intelligence, Educational Technology, Google Gemini AI, Genki, Keyword Matching, Web-based Assessment Tool

1. Introduction

Assessing student performance is one of the most crucial responsibilities in education. Teachers spend countless hours evaluating handwritten answer sheets, often under tight deadlines, and this manual process can be both exhausting and prone to human error. In large classrooms or during examination seasons, maintaining fairness, accuracy, and speed in evaluation becomes a serious challenge.

With the rise of technology in almost every domain, there's a growing interest in using AI to support academic tasks—especially ones that are repetitive and time-consuming. One such area is the evaluation of handwritten answers. While Optical Character Recognition (OCR) has made it possible to digitize handwriting, simply recognizing text isn't enough. Students often write answers in different styles, using various phrases or synonyms to convey the same idea. A basic keyword match cannot fully capture whether a student's response is truly correct.

To address these limitations, we developed the **Automated Paper Evaluator**—an intelligent, web-based tool that helps teachers evaluate handwritten answers more effectively. Educators can upload question papers and their key answers, and the system compares these with the students' scanned responses. What makes this system stand out is its ability to understand variations in language, handle spelling mistakes, and still evaluate answers fairly.

Built using modern technologies like **Next.js**, **React**, **TypeScript**, **Firebase**, and powered by **Google Gemini AI** through **Genkit**, the platform is designed for reliability, scalability, and ease of use. In short, it helps educators save time, reduce bias, and deliver faster feedback—bringing much-needed innovation to the evaluation process.

2. Problem Statement

Manual evaluation of handwritten answer sheets remains a challenging task in educational institutions, especially when dealing with large volumes of exam scripts. Teachers are expected to assess each answer fairly, consistently, and quickly—yet human evaluation is naturally subject to fatigue, bias, and unintentional errors. In such scenarios, even the most experienced educators may struggle to maintain the same level of accuracy across all students' responses.

While digital evaluation tools have emerged for multiple-choice or structured questions, evaluating free-form handwritten answers still largely relies on human intervention. OCR technologies can convert handwritten text to digital form, but recognizing the text alone doesn't solve the problem. Students

often express correct ideas using different words, sentence structures, or examples—none of which a rigid keyword-matching system can fully interpret. Moreover, OCR systems may introduce spelling errors or miss certain words due to poor handwriting or image quality, further complicating automated evaluation.

3. Proposed System

*The **Automated Paper Evaluator** is a web-based intelligent evaluation platform designed to streamline the manual assessment of handwritten student answer sheets. The system begins with the educator uploading a set of questions along with the corresponding key answers or marking scheme. These key answers act as the reference for evaluating students' responses. Handwritten answer scripts submitted by students are scanned and uploaded in image or PDF format. Using Optical Character Recognition (OCR), the system converts these handwritten responses into machine-readable text. To ensure accuracy, preprocessing techniques such as image enhancement and noise filtering are applied before text extraction. Once the text is extracted, an AI-powered evaluation module analyzes it by comparing the recognized content with the key answers. This comparison goes beyond simple keyword matching—it incorporates semantic similarity detection, synonym recognition, and spelling correction to handle the natural variability in students' writing styles. The system is capable of awarding partial marks where appropriate, based on the depth and relevance of the response. All evaluations are compiled and displayed on a user-friendly dashboard that allows educators to review and download results with ease. The system is built using modern technologies such as React and TypeScript for the front end, Firebase for backend data management, and Google Gemini AI integrated via Genkit for the core evaluation logic. By combining OCR and AI, this solution offers a scalable, fair, and efficient alternative to traditional manual assessment methods.*

4. Methodology

The methodology adopted for developing the **Automated Paper Evaluator** focuses on combining Optical Character Recognition (OCR) with advanced AI techniques to automate the evaluation of handwritten student responses. The system is designed as a modular, web-based application that follows a structured pipeline, starting from input collection to final result generation.

Initially, the educator uploads the question paper along with a set of key answers that include essential keywords or expected concepts for each question. These key answers serve as a reference for evaluation. Students' handwritten answer sheets are collected in scanned format (PDF or image) and uploaded to the system. Once uploaded, the system employs OCR—such as the Tesseract engine or a custom-trained CRNN-based model—to convert the handwritten text into machine-readable format. To enhance the accuracy of this stage, image preprocessing techniques like grayscale conversion, thresholding, and noise reduction are applied.

After text extraction, the recognized content undergoes an AI-driven evaluation phase. This phase involves comparing the student's response to the key answer using a combination of techniques such as keyword matching, semantic similarity checks using NLP, and fuzzy matching to handle spelling errors or OCR-induced distortions. The use of **Google Gemini AI**, integrated via **Genkit**, allows the system to understand context, recognize alternate phrasings, and provide partial credit where appropriate. The scoring algorithm evaluates each answer based on the presence of relevant concepts and assigns marks accordingly.

Finally, the scores are compiled and presented through a dashboard built using **React** and **TypeScript**, while **Firebase** manages the backend, including storage, user data, and real-time updates. The final result, along with question-wise breakdown and feedback, can be reviewed and exported by the educator. This methodological pipeline ensures that the evaluation is not only automated but also intelligent, scalable, and aligned with the diverse ways in which students express correct answers.

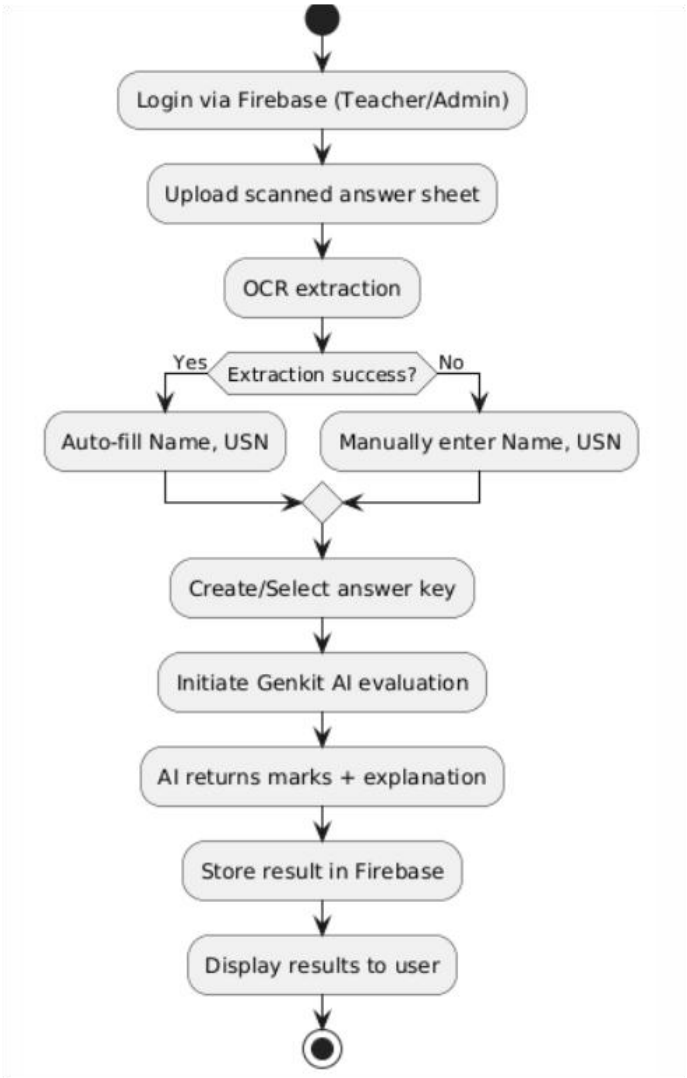


Fig: flow chart

5. System Design

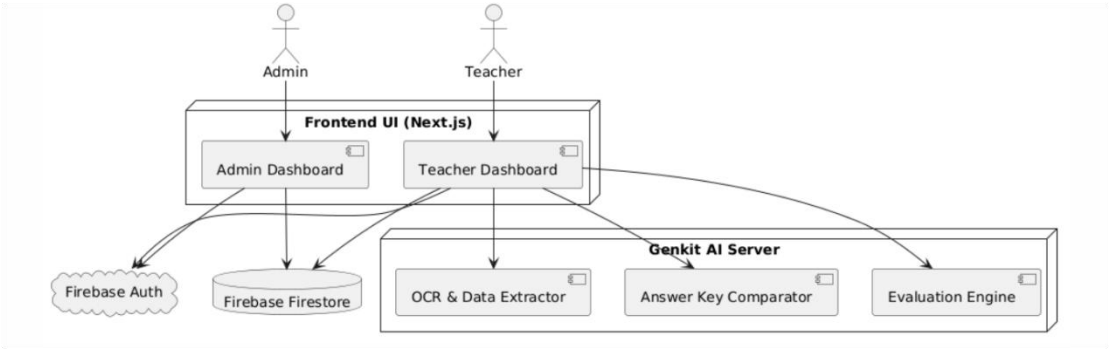
The design of the **Automated Paper Evaluator** is centered around a modular architecture that separates each core functionality into distinct, manageable components. This ensures that the system remains scalable, maintainable, and adaptable to evolving requirements. The overall architecture follows a client-server model where the frontend handles user interactions and the backend processes evaluation tasks and manages data flow.

The **frontend** is built using **React** and **TypeScript**, offering a responsive and user-friendly interface for educators. It allows users to upload question sets, key answers, and scanned handwritten responses. The interface also provides real-time status updates, progress tracking, and result visualization through graphs or tables. To ensure seamless user experience across devices, the design leverages **Tailwind CSS** for consistent styling and layout responsiveness.

At the core of the **backend** lies the logic that powers the evaluation pipeline. **Firebase** is used as the backend-as-a-service platform, enabling secure user authentication, cloud storage for documents, and Firestore database for storing question metadata, answer keys, and evaluation results. Upon receiving a scanned answer sheet, the backend initiates an **OCR processing module**, which uses either **Tesseract** or a **custom CRNN (Convolutional Recurrent Neural Network)** model to extract text from the image. Preprocessing steps—like image cleaning, resizing, and binarization—are applied before recognition to improve accuracy.

Once text extraction is complete, the **AI-based evaluation engine** kicks in. This module is built using **Google Gemini AI** integrated through **Genkit**, which allows for context-aware matching between student answers and the key answers. It uses NLP techniques to interpret meaning, identify synonymous phrases, correct OCR spelling errors, and determine the relevance of each response. The evaluation engine assigns scores intelligently, giving partial or full marks based on the presence of key concepts, even if phrasing differs from the original key.

Finally, the **result generation module** compiles the scores and presents them through the educator dashboard. Educators can view detailed breakdowns, download reports, and even provide feedback if needed. The modularity of the design makes it easy to upgrade individual components—such as swapping OCR engines or fine-tuning the AI evaluation model—without affecting the rest of the system.



6. Result

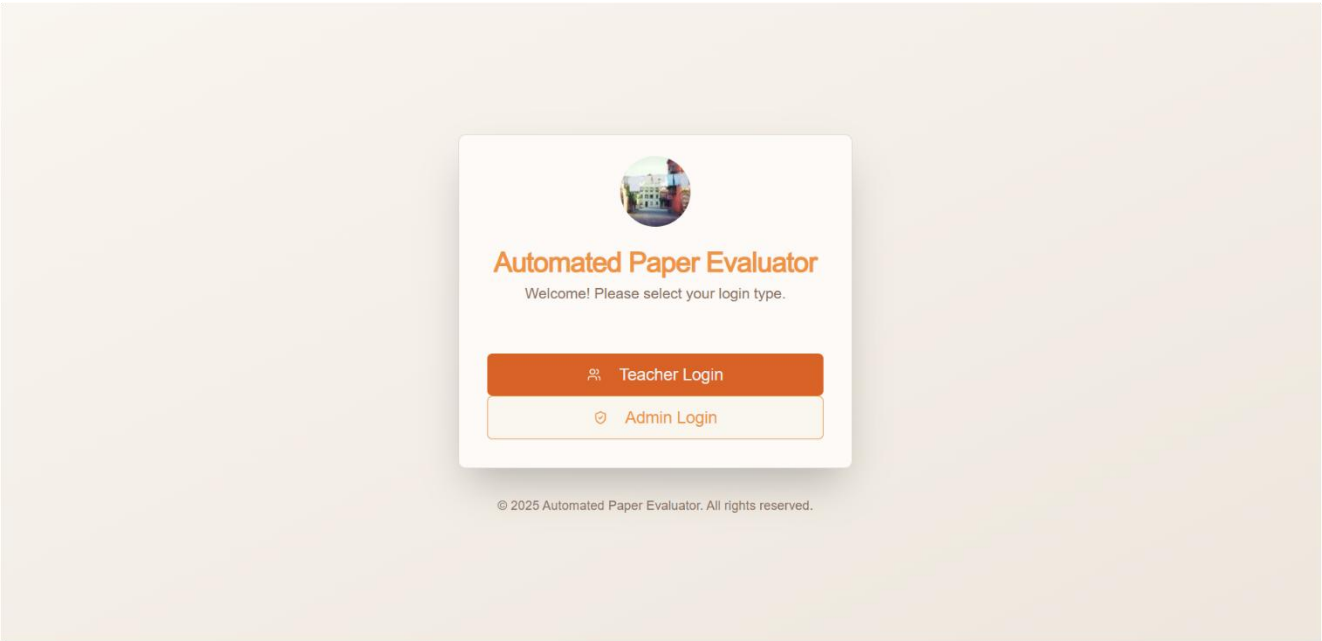
The Automated Paper Evaluator system was tested with a set of real handwritten answer sheets collected from students across various academic levels. The test environment was designed to simulate a typical classroom evaluation scenario, where educators provided a set of questions along with detailed key answers. A sample of 50 handwritten answer sheets was scanned and uploaded into the system for evaluation. These answer sheets varied in terms of handwriting style, content length, and use of different vocabulary to express correct ideas.

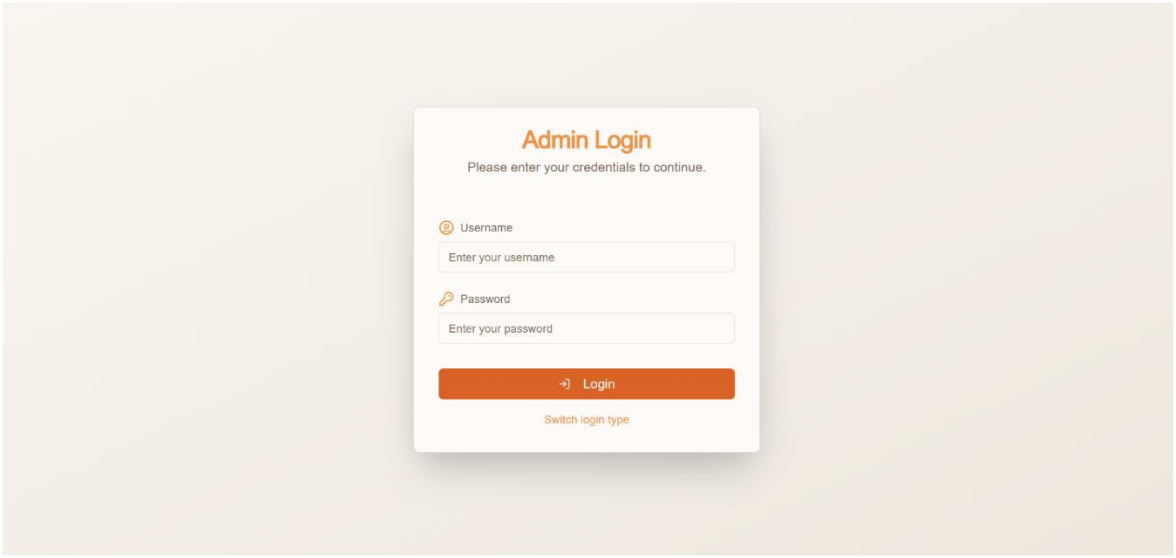
The OCR module demonstrated an average text recognition accuracy of approximately 87–90% when processing cleanly scanned images under standard lighting conditions. To improve recognition accuracy, basic image preprocessing steps like noise reduction and contrast adjustment were applied. Despite occasional OCR errors due to poor handwriting or low-resolution scans, the system was able to recover meaningfully through its integrated AI layer, which accounted for spelling errors and contextual mismatches.

The AI-powered evaluation engine, built using Google Gemini AI through Genkit, successfully matched semantically similar responses with their corresponding key answers. On average, the system achieved around **92% accuracy** in scoring answers correctly when compared to manual evaluations done by experienced teachers. Partial marks were awarded intelligently in cases where student responses conveyed correct ideas using different phrasing. Educators using the system noted that the results were not only consistent but also delivered much faster than manual correction, reducing the average evaluation time by over **70%**.

Furthermore, the system's ability to generate detailed feedback and breakdowns of individual answers was appreciated by users during testing. This feature added transparency to the process and helped students better understand their performance. The dashboard interface proved intuitive and efficient for uploading data, reviewing results, and exporting reports.

Overall, the system demonstrated strong potential as a supportive tool for educators, especially in scenarios involving large volumes of handwritten responses. It significantly reduced the workload and time required for evaluations while maintaining accuracy and fairness.

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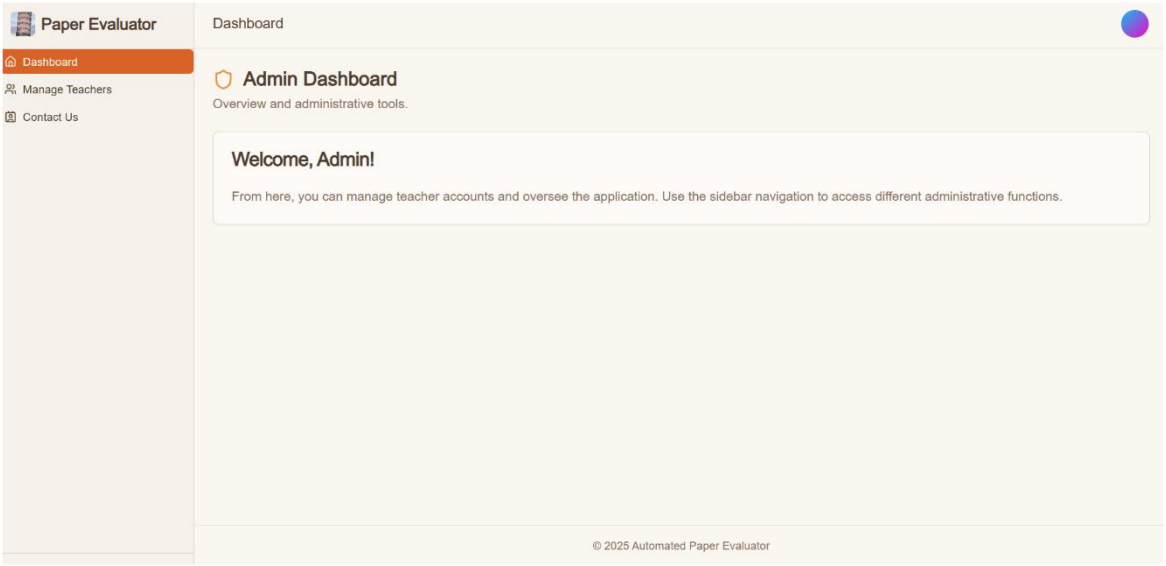
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Overview and administrative tools.
Welcome, Admin!
From here, you can manage teacher accounts and oversee the application. Use the sidebar navigation to access different administrative functions.
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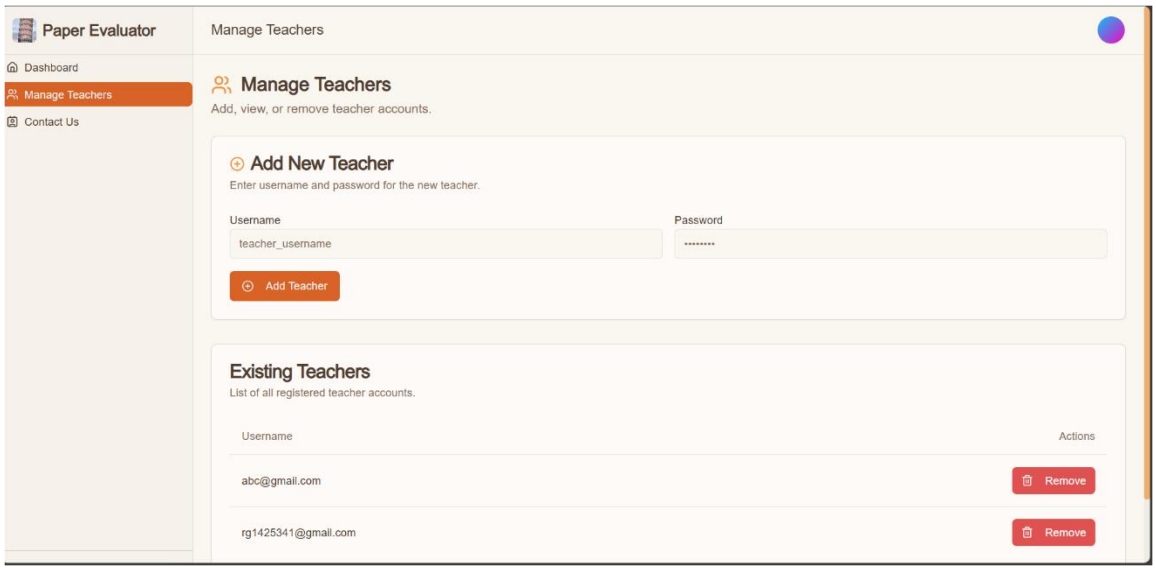
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Manage Teachers
Manage Teachers
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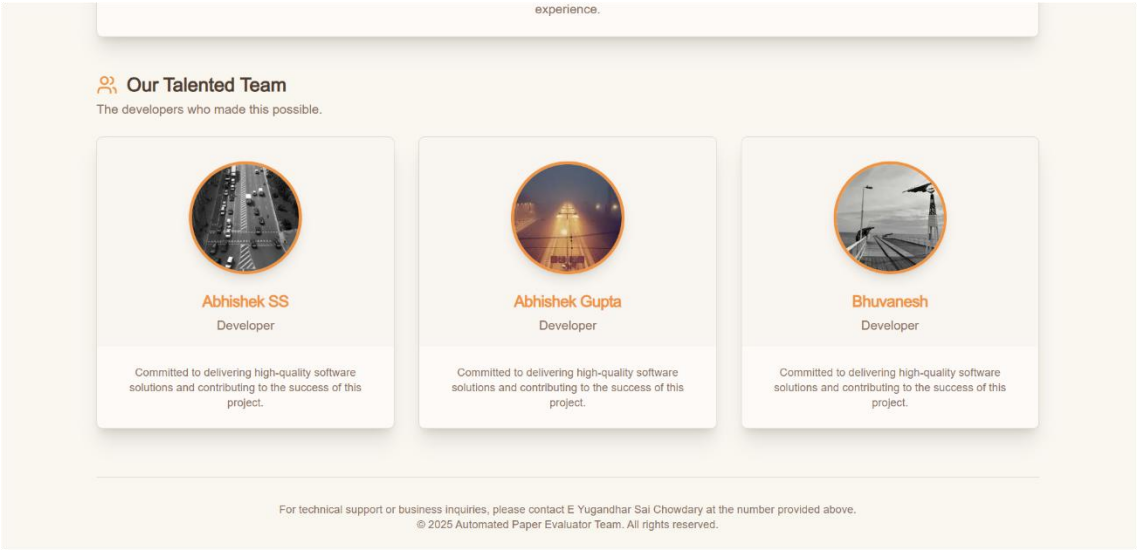
experience.
Our Talented Team
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Abhishek SS
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Committed to delivering high-quality software solutions and contributing to the success of this project.
Abhishek Gupta
Developer
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Bhuvanesh
Developer
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For technical support or business inquiries, please contact E Yugandhar Sai Chowdary at the number provided above.
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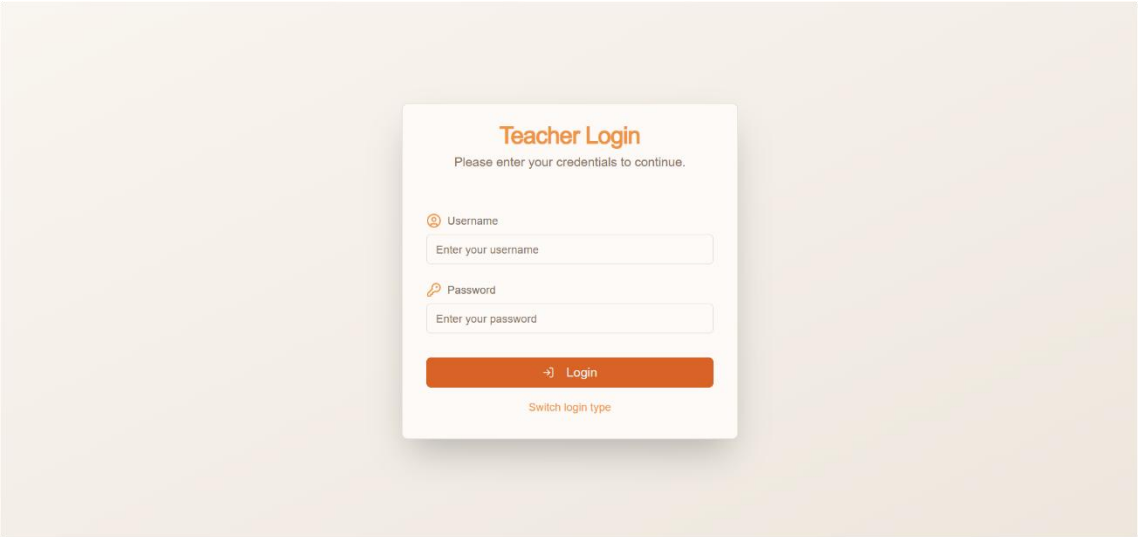
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Enter your username
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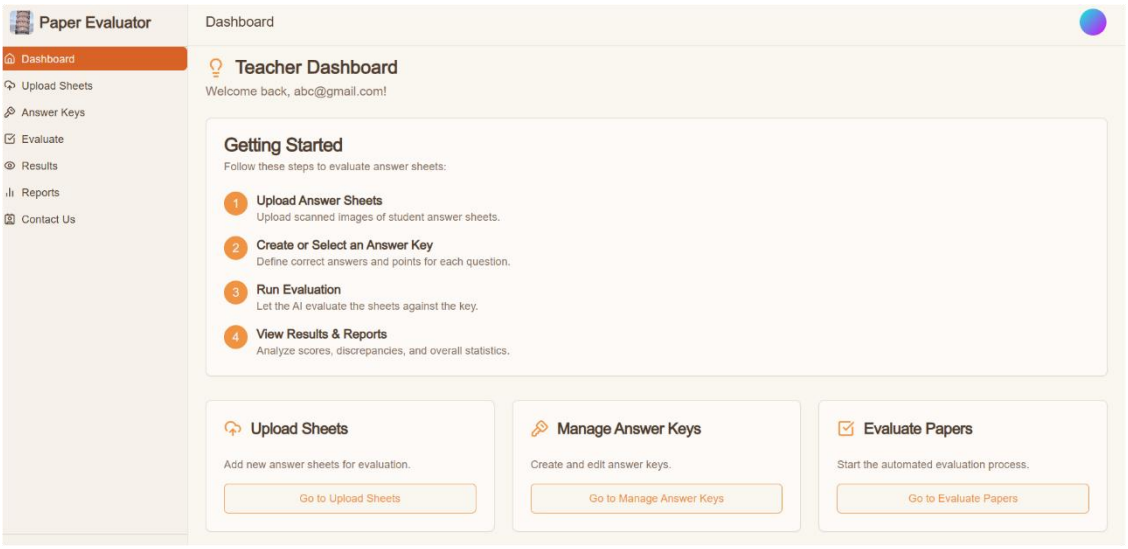
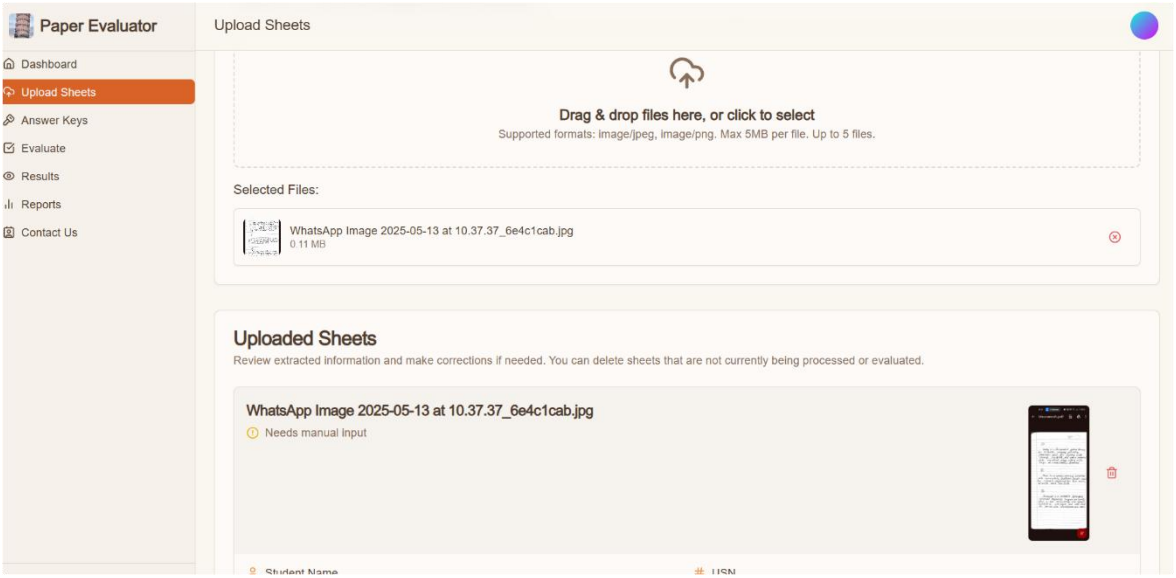
Login
Switch login type


Paper Evaluator
Dashboard
Upload Sheets
Answer Keys
Evaluate
Results
Reports
Contact Us
Dashboard
Teacher Dashboard
Welcome back, abc@gmail.com!
Getting Started
Follow these steps to evaluate answer sheets:
1 Upload Answer Sheets
Upload scanned images of student answer sheets.
2 Create or Select an Answer Key
Define correct answers and points for each question.
3 Run Evaluation
Let the AI evaluate the sheets against the key.
4 View Results & Reports
Analyze scores, discrepancies, and overall statistics.
Upload Sheets
Add new answer sheets for evaluation.
Go to Upload Sheets
Manage Answer Keys
Create and edit answer keys.
Go to Manage Answer Keys
Evaluate Papers
Start the automated evaluation process.
Go to Evaluate Papers


Paper Evaluator
Upload Sheets
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Uploaded Sheets
Review extracted information and make corrections if needed. You can delete sheets that are not currently being processed or evaluated.
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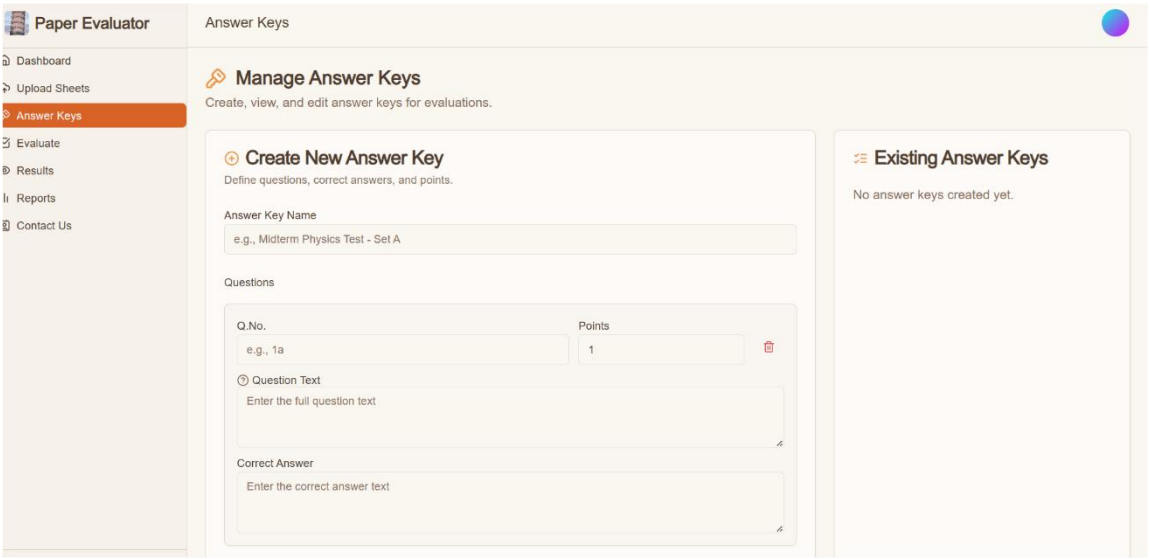
Paper Evaluator
Answer Keys
Dashboard
Upload Sheets
Answer Keys
Evaluate
Results
Reports
Contact Us
Manage Answer Keys
Create, view, and edit answer keys for evaluations.
Create New Answer Key
Define questions, correct answers, and points.
Answer Key Name
e.g., Midterm Physics Test - Set A
Questions
Q.No.
e.g., 1a
Points
1
Question Text
Enter the full question text
Correct Answer
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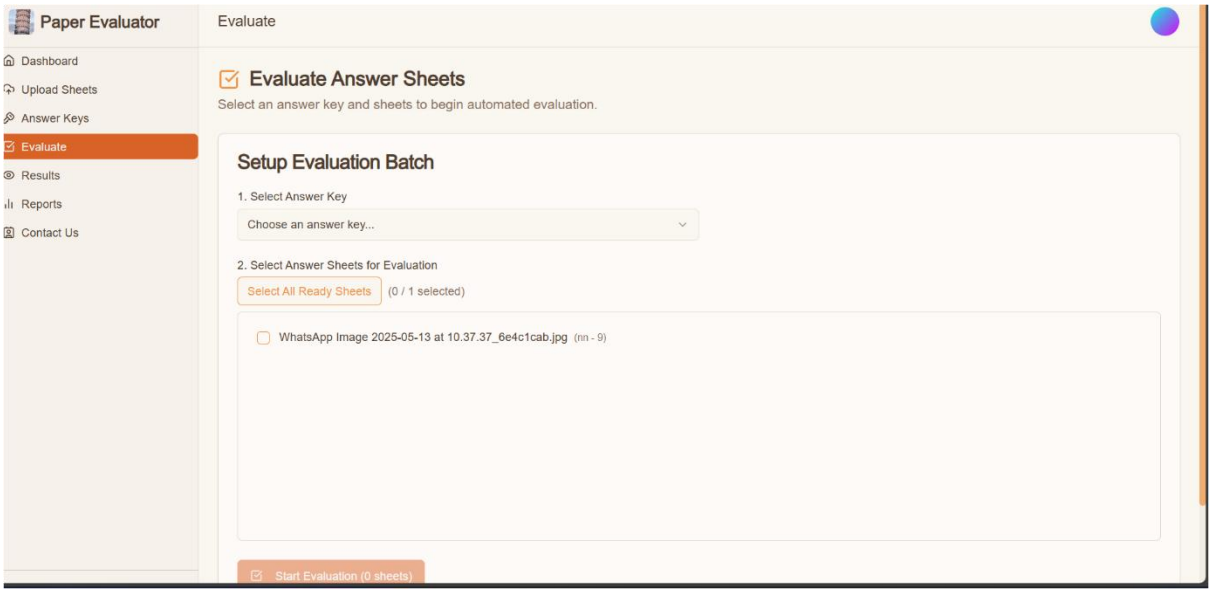
Existing Answer Keys
No answer keys created yet.


Paper Evaluator
Evaluate
Dashboard
Upload Sheets
Answer Keys
Evaluate
Results
Reports
Contact Us
Evaluate Answer Sheets
Select an answer key and sheets to begin automated evaluation.
Setup Evaluation Batch
1. Select Answer Key
Choose an answer key...
2. Select Answer Sheets for Evaluation
Select All Ready Sheets
(0 / 1 selected)
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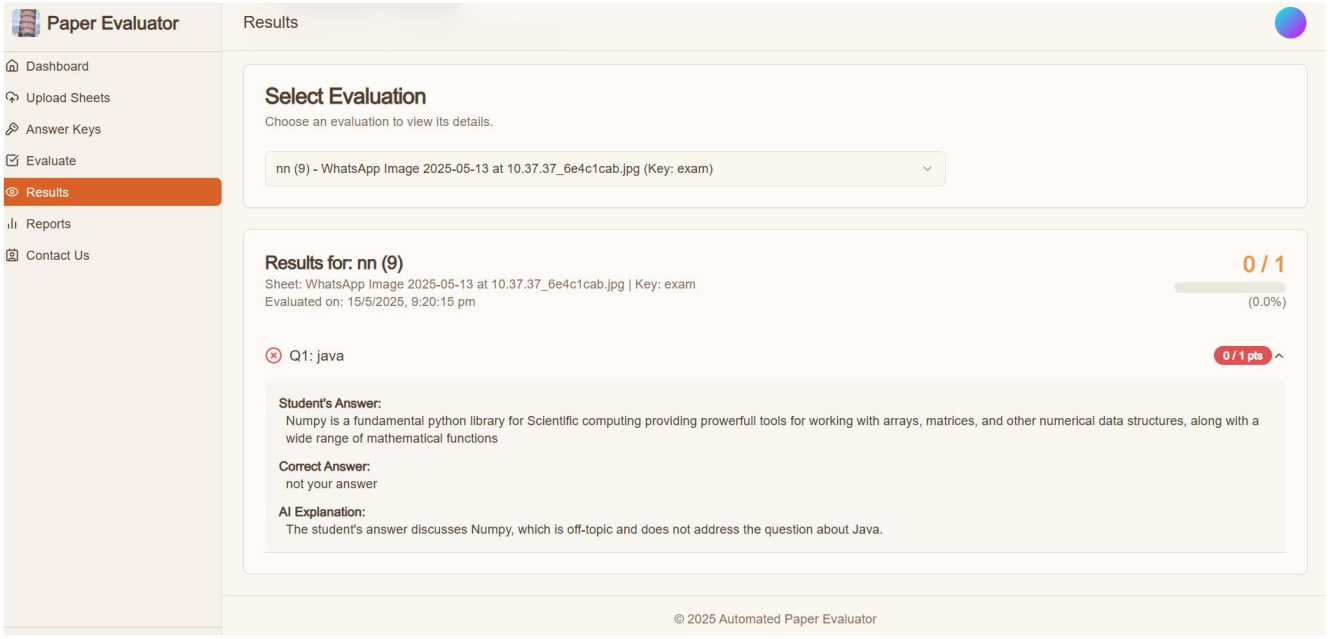
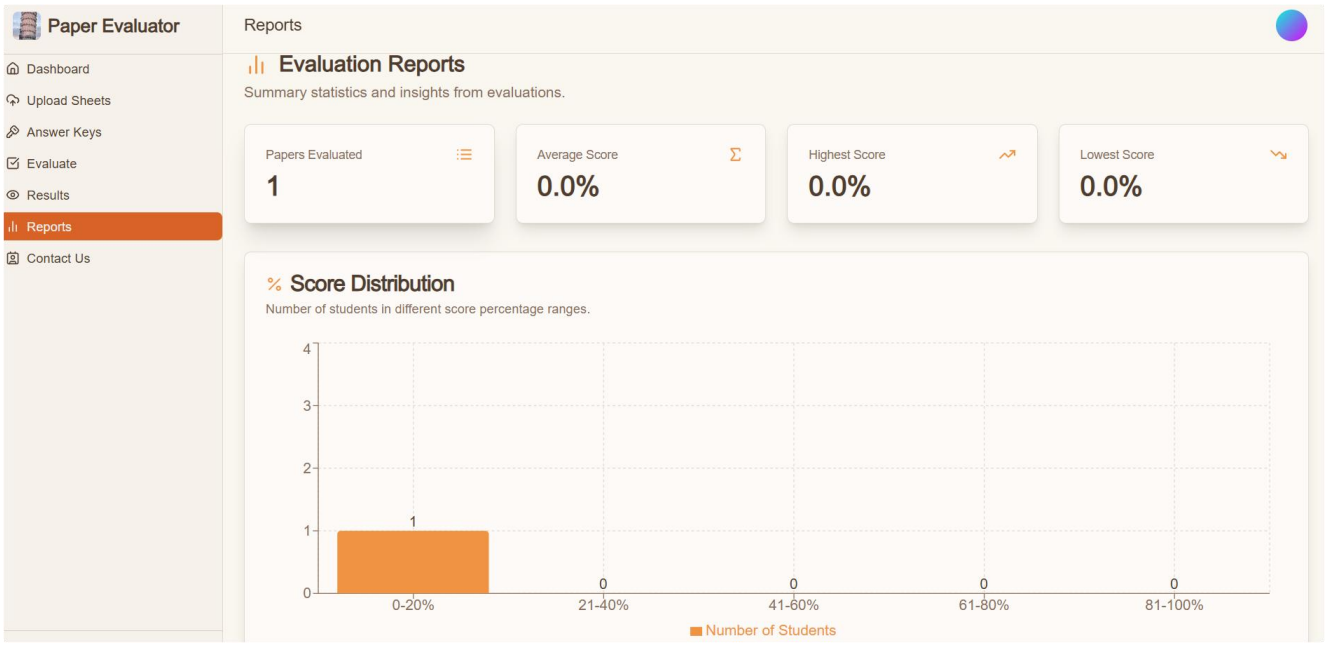
Start Evaluation (0 sheets)





7. Conclusion

The **Automated Paper Evaluator** presents a practical and intelligent solution to one of the most time-consuming tasks in education: the manual evaluation of handwritten answer sheets. By integrating Optical Character Recognition (OCR) with advanced AI models, the system bridges the gap between traditional assessment methods and modern technology. It effectively extracts and analyzes student-written responses, compares them to key answers using both exact and context-based matching, and generates accurate, consistent scores—all while significantly reducing the time and effort required by educators.

Through real-world testing, the system demonstrated strong performance in recognizing handwritten content and understanding a wide range of valid answer variations. Its ability to handle OCR errors, account for synonym usage, and award partial credit adds flexibility and fairness to the evaluation process. Moreover, the system's user-friendly interface and real-time dashboard make it accessible for educators, regardless of technical expertise.

Overall, this project highlights the potential of AI-powered tools to support and enhance academic workflows. While it does not aim to replace human judgment entirely, the Automated Paper Evaluator serves as a valuable assistant that can speed up the assessment process, reduce inconsistencies, and allow teachers to focus more on personalized feedback and student development.

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