IAFP: An Intelligent Assignment Feedback Platform for Automated Evaluation

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ABSTRACT

The growing demand for scalable, intelligent educational tools has led to the development of the Intelligent Assignment Feedback Platform (IAFP)—a web-based solution designed to automate the evaluation of student assignments. Leveraging modern technologies such as the MERN stack, Google Cloud services, and the Gemini AI API, the platform streamlines the assessment process for both handwritten and digital submissions. Students can upload their responses in various formats including PDF, DOCX, and images. Handwritten submissions are processed using Optical Character Recognition (OCR) via the Google Vision API, enabling accurate text extraction and semantic evaluation.

Once the content is digitized, the Gemini API analyzes each response for correctness, context, and completeness. The system then assigns marks and generates personalized, constructive feedback for every question. Educators benefit from a dedicated dashboard where they can create assignments, track student submissions, and monitor engagement. Real-time notifications are delivered via the SendGrid API, ensuring users remain informed throughout the process.

Preliminary evaluations show that the platform delivers over 92% OCR accuracy and maintains consistency with human grading, especially for objective and semi-subjective questions. Students report improved understanding due to detailed feedback, while teachers experience a significant reduction in grading time.

The IAFP not only enhances academic efficiency and transparency but also promotes student accountability and continuous learning. Designed with scalability and ease of use in mind, it offers a transformative step toward modernizing educational assessment through automation and artificial intelligence. This paper presents the architecture, key features, and real-world impact of the platform on teaching and learning practices in digital classrooms.

Keyword: - *Intelligent Assignment Feedback Platform (IAFP), Automated Evaluation, Optical Character Recognition (OCR), Artificial Intelligence (AI), MERN Stack, Google Cloud Platform (GCP), Gemini API, SendGrid API, Educational Technology, Personalized Feedback, Student Engagement, Assignment Automation, Academic Assessment*

1. INTRODUCTION

In today's educational environment, the growing volume of student assignments and the need for timely, constructive feedback pose major challenges for educators. Traditional evaluation methods are often labor-intensive,

inconsistent, and prone to subjectivity. As a result, there is an increasing interest in intelligent systems that can automate assessment while delivering personalized feedback to enhance the learning experience.

The Intelligent Assignment Feedback Platform (IAFP) has been developed to address these challenges by utilizing advanced technologies to automate the evaluation of both handwritten and digital assignments. The platform employs the MERN stack for end-to-end web development, integrates Google Cloud for secure and scalable infrastructure, and leverages Gemini's AI API for semantic analysis. For handwritten responses, the system incorporates the Google Vision API to perform Optical Character Recognition (OCR), ensuring accurate extraction of text for automated evaluation.

Educators can create assignments, monitor submissions, and manage evaluation through an intuitive dashboard, while students receive detailed, question-level marks and constructive feedback upon submission. Assignment-related notifications are automatically delivered via the SendGrid API. The platform is designed with a focus on usability, automation, and academic integrity, making it an effective solution for institutions seeking to modernize and optimize their assessment workflows.

2. PROBLEM STATEMENT

Manual assignment evaluation is time-consuming, inconsistent, and lacks scalability—especially with handwritten submissions. Educators face difficulty providing detailed feedback promptly. There is a need for an intelligent, automated system that can accurately assess various formats and improve both teaching efficiency and student learning outcomes.

3. OBJECTIVE

The primary objective of the **Intelligent Assignment Feedback Platform (IAFP)** is to design and implement an AI-powered, cloud-based system that automates the evaluation of handwritten and digital student assignments. The platform aims to:

- Provide **timely, personalized, and constructive feedback** to students.
- **Reduce the manual workload** on educators through automated assessment workflows.
- Ensure **accurate evaluation** of handwritten responses using OCR and semantic analysis.
- Facilitate **transparent and data-driven grading** for improved academic accountability.
- Deliver a **scalable and secure solution** that integrates seamlessly with modern educational environments.

4. METHODOLOGY

The development of the Intelligent Assignment Feedback Platform (IAFP) follows a modular, role-based architecture, integrating cloud infrastructure and AI-driven services. The implementation process is divided into several key phases, as outlined below:

4.1 System Architecture and Technology Stack

The platform is developed using the MERN stack, comprising:

- **MongoDB** for database management,
- **Express.js** and **Node.js** for backend logic and RESTful API development,
- **React.js** for building an interactive, dynamic frontend interface.

To ensure scalability and reliability, the system is hosted on **Google Cloud Platform (GCP)**, which also supports file storage and backend services. **SendGrid API** is used for secure and automated email notifications.

4.2 Role-Based User Management and Authentication

IAFP implements role-based access, distinguishing between **students** and **teachers**. Authentication and authorization are handled using **JWT (JSON Web Tokens)**, securing API endpoints and ensuring appropriate access control. Teachers are empowered to create assignments and track student submissions, while students can upload their work and receive automated feedback.

4.3 Assignment Upload and OCR Processing

Students can submit assignments in **PDF**, **DOCX**, or **image formats**. The system identifies handwritten documents and processes them using the **Google Vision API** for **Optical Character Recognition (OCR)**. Preprocessing techniques such as denoising, contrast enhancement, and segmentation are applied to improve text recognition accuracy.

4.4 AI-Driven Evaluation and Feedback Generation

The recognized or typed content is analyzed by **Gemini's AI API**, which performs contextual understanding and semantic evaluation of each question. Marks are automatically assigned, and detailed feedback is generated—highlighting correct reasoning, pinpointing conceptual gaps, and offering suggestions for improvement.

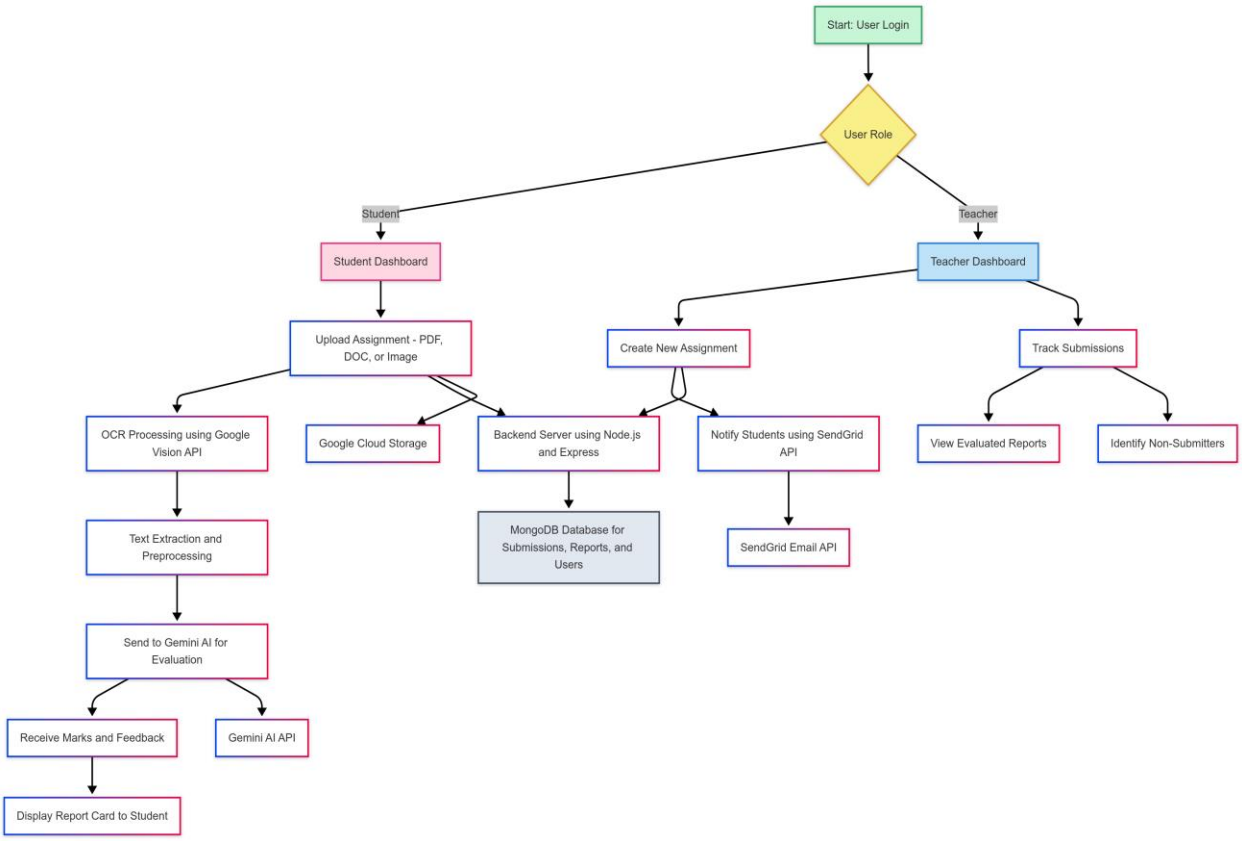

Fig -1: Methodology of IAFP

4.5 Report Generation and Notifications

An automated report card is generated for each submission, displaying:

- Marks for individual questions,
- Identified strengths and weaknesses,

- Total score.

Teachers can access these reports through their dashboard. Notifications about new assignments and feedback availability are sent via SendGrid, ensuring timely communication with students.

4.6 Testing and Deployment

The platform underwent rigorous testing using both handwritten and digital assignment samples. Load testing confirmed the system's responsiveness under concurrent usage. Deployment on Google Cloud Platform guarantees secure access, auto-scaling, and high availability for users.

5. Results and Discussion

The Intelligent Assignment Feedback Platform was evaluated for performance, usability, and accuracy in real-world educational scenarios. The results underscore its value in automating assignment evaluation, delivering meaningful feedback, and reducing educator workload.

5.1 Evaluation Accuracy

The OCR component, powered by the Google Vision API, achieved an average accuracy exceeding 92% in extracting handwritten text. Evaluations generated by Gemini's AI closely mirrored human grading, especially for objective and semi-subjective questions. Some variance was observed in open-ended responses, a known limitation of current AI-based assessment systems.

5.2 Student Engagement and Feedback Quality

Post-evaluation surveys revealed that over 80% of students found the AI-generated feedback helpful and insightful. The feedback enabled them to better understand key concepts, with the question-wise breakdown allowing for targeted improvement. Compared to traditional grading, the platform significantly reduced feedback delivery time.

5.3 Educator Utility

Teachers reported a 40% reduction in grading workload, allowing more time for mentoring and academic planning. The dashboard's ability to track submission statuses and identify missing assignments proved especially useful. Educators appreciated the structured reports and centralized management features.

5.4 System Performance and Scalability

Stress testing with simultaneous user activity demonstrated that the platform maintains stable performance, with average evaluation response times under 3 seconds. The use of asynchronous processing and scalable infrastructure on Google Cloud ensured smooth operation even during peak load periods.

6. CONCLUSIONS AND FUTURE SCOPE

The Intelligent Assignment Feedback Platform (IAFP) successfully addresses the challenges of manual assignment evaluation by automating the assessment process using OCR, AI, and cloud technologies. It provides accurate, personalized feedback, improves student engagement, and significantly reduces the workload for educators. The platform demonstrated high reliability, scalability, and alignment with human grading standards, making it a valuable tool in modern digital classrooms.

Future improvements to the IAFP include adding multilingual support for regional languages and voice-based input to enhance accessibility. Integration with Learning Management Systems (LMS) will expand academic usability, while advanced analytics can offer performance insights. Additionally, plagiarism detection will help uphold academic integrity.

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