International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Vaolume 13, Issue 12, December-2025, Available online at: www.ijaresm.com

Automated Answer Sheet Evaluation System

Khushbu Dinesh Pande[1], Saloni Amarnath Navgire[2], Sakshi Jitendra Tak[3], Vaishnavi Shriram Deshmukh[4], Mr. Suhas. G. Salve[5]

[1,2,3,4]B.Tech.FinalyearStudents,Dept.ofComputerScienceandEngg.,MGM'sCollegeofEngineering,Nanded, Maharashtra, India
[5]Guide,Asst.Prof.(M.Tech , B.E),Dept.ofComputerScienceandEngg.,MGM'sCollegeofEngineering, Nanded, Maharashtra, India.

----------**********----------

ABSTRACT

Manual evaluation of handwritten answer sheets is time-consuming and error-prone. Digimark automates this process using a six-stage pipeline: PDF conversion (pdf2image + Poppler) → image preprocessing (OpenCV) → text extraction (Tesseract OCR) → Natural Language Processing (NLP) processing (NLTK + WordNet lemmatization) → semantic evaluation (keyword matching) → PDF report generation (FPDF). The Flask-based web interface allows teachers to upload answer sheets and receive evaluated reports with per-question marks and feedback instantly. The system reduces grading time by 80-90%, supports multi-page batch processing, and ensures consistent evaluation. With high accuracy on quality scans, Digimark demonstrates practical application of computer vision and NLP in educational assessment automation.

Keywords: Optical Character Recognition (OCR),NLP,Handwritten Text Recognition,Tesseract OCR,OpenCV Image Processing, NLTK Lemmatization, WordNet,Keyword Matching.pdf2image,Poppler,FPDF Report Generation.

INTRODUCTION

The evaluation of handwritten answer sheets is a crucial component of the educational system. Traditionally, this task is carried out manually by teachers, requiring significant time and effort. Manual grading is not only slow but also prone to human errors, fatigue, and inconsistency, particularly when evaluating a large number of answer sheets. These limitations often lead to delayed results and uneven assessment standards across students.

With recent advancements in **computer vision** and **artificial intelligence**, automated evaluation systems have emerged as an effective solution to these challenges. Technologies such as **Optical Character Recognition (OCR)** and **Natural Language Processing (NLP)** enable machines to read, process, and understand handwritten text. **Digimark** is an automated handwritten answer sheet evaluation system that converts uploaded PDF answer sheets into images, enhances them through image preprocessing, extracts handwritten text using OCR, and evaluates responses using NLP-based semantic analysis. Through a user-friendly Flask-based web interface, Digimark provides instant per-question marks and feedback, significantly reducing grading time while ensuring consistent, accurate, and scalable evaluation.

Digimark Evaluation Framework: Details and Architecture
The Digimark – Digital Marking System for Handwritten Answer Sheets is an AI-driven web-based platform designed to automate the evaluation of handwritten examination papers. The system analyzes scanned or uploaded answer sheets in PDF format and assigns marks by comparing student responses with predefined model answers. Digimark addresses key challenges such as time-consuming manual grading, human errors, inconsistent evaluation, and delayed result generation by integrating image processing, Optical Character Recognition (OCR), and Natural Language Processing (NLP) techniques. Built using open-source technologies, the platform is accessible across devices and ensures ease of use for educators.

System Architecture:
Digimark follows a three-tier architecture to ensure scalability, modularity, and secure data handling:
1. Presentation Layer - Developed using HTML, CSS, JavaScript, and Bootstrap, this layer provides a clean and intuitive web interface for teachers. Users can upload PDF answer sheets, select evaluation parameters, and view results instantly. The interface displays per-question marks and feedback in a structured format and supports multi-page and batch uploads for efficient evaluation.

"This work is licensed under a Creative Commons Attribution 4.0 International License."
License url: https://creativecommons.org/licenses/by/4.0

2. Application Layer - The application layer is powered by Flask (Python) and serves as the core processing unit of the system. It manages file uploads, validation, and the complete evaluation workflow. Uploaded PDFs are converted into images using pdf2image and Poppler, followed by image preprocessing with OpenCV to enhance text quality. Tesseract OCR is used to extract handwritten text, which is then processed using NLTK for tokenization and WordNet-based lemmatization. Semantic evaluation is performed through keyword matching between student answers and model answers. Marks are calculated automatically, and detailed evaluation reports are generated using the FPDF library.

3. Data Layer - The data layer uses SQLite to store evaluation results, answer metadata, model answers, and report details. Secure data handling mechanisms ensure reliability and consistency in result storage. The database also supports retrieval of past evaluations for reference and reporting.

Model Performance and Features:
The Digimark system delivers high accuracy for clearly scanned handwritten answer sheets. It significantly reduces grading time by approximately 80–90% compared to manual evaluation while maintaining consistent marking standards. The platform supports multi-page batch processing, automated PDF report generation, and instant feedback for each question. Input validation ensures only valid PDF files are accepted, improving system robustness.

By combining computer vision and NLP techniques, Digimark demonstrates a practical and efficient approach to educational assessment automation, offering a scalable solution for modern digital evaluation systems.

Existing Answer Sheet Evaluation Systems and AI Influence
Traditional evaluation of handwritten answer sheets is largely manual and paper-based, requiring teachers to read each response, interpret handwriting, and assign marks individually. This process is time-consuming, labor-intensive, and prone to human errors, especially when handling large volumes of answer sheets. Examiner fatigue, subjective judgment, and inconsistent marking standards often affect the fairness and accuracy of results. Existing digital tools, where available, mainly support objective-type questions or require manual data entry, offering limited support for descriptive answer evaluation.

Some semi-automated systems use basic Optical Character Recognition (OCR) to extract handwritten text but lack effective semantic understanding of student answers. These systems usually provide only raw text output without meaningful evaluation, feedback, or per-question scoring. Additionally, they struggle with multi-page document handling and fail to deliver real-time results or detailed reports, reducing their practicality in academic environments.

The proposed Digimark system introduces an AI-driven approach by integrating OCR, image processing, and Natural Language Processing (NLP) techniques to automate descriptive answer evaluation. Using Tesseract OCR, keyword matching, and WordNet-based lemmatization, Digimark evaluates answers based on relevance rather than exact word matching. It supports multi-page batch processing, instant PDF report generation, and consistent evaluation criteria, reducing grading time by 80–90% while ensuring accurate, unbiased, and scalable assessment for educational institutions.

LITERATURE SURVEY

The field of automated answer sheet evaluation has evolved significantly with advancements in Optical Character Recognition (OCR), image processing, and Natural Language Processing (NLP) techniques.

1. **Traditional Evaluation Systems**:Smith et al. [1] discussed manual grading methods used in educational institutions, highlighting issues such as examiner fatigue, subjectivity, and delayed result processing. Although reliable, these systems are time-intensive and lack scalability for large student populations.
2. **OCR-Based Systems**:Patel and Kumar [2] developed an OCR-based system to digitize handwritten answer sheets. While the system successfully extracted text, it focused mainly on digitization and did not support semantic evaluation or automated mark allocation.
3. **Rule-Based Evaluation Tools**:Rao et al. [3] proposed a rule-based assessment system using keyword matching for descriptive answers. However, the system was limited by exact word matching, making it sensitive to variations in student responses and reducing evaluation accuracy.
4. **NLP-Based Evaluation Approaches**:Ahmed and Singh [4] introduced an NLP-based answer evaluation framework using tokenization and stemming techniques. Although the system improved flexibility in answer evaluation, it struggled with synonym recognition and required extensive manual tuning.
5. **Hybrid OCR–NLP Systems**:Verma et al. [5] presented a hybrid system combining OCR and NLP for automated grading. Despite improved performance, the system lacked a user-friendly web interface and did not support multi-page

"This work is licensed under a Creative Commons Attribution 4.0 International License."
License url: https://creativecommons.org/licenses/by/4.0

batch processing or automated report generation.

The proposed Digimark system advances existing research by integrating Tesseract OCR, OpenCV image preprocessing, and NLP techniques such as WordNet-based lemmatization within a scalable Flask-based web application. Unlike earlier systems, Digimark supports multi-page batch evaluation, consistent semantic scoring, and automatic PDF report generation, making it more practical, accessible, and suitable for real-world academic environments.

METHODOLOGY

1.Identifying Requirements:
We conducted a thorough analysis of existing manual and semi-automated answer sheet evaluation systems to understand user challenges such as time-consuming grading, inconsistent marking, and difficulty handling large volumes of handwritten papers. Key user-driven requirements include:

- Accurate extraction of handwritten text from scanned answer sheets using OCR
- Consistent and unbiased evaluation of descriptive answers
- Reduced grading time and minimized examiner workload
- Automated generation of per-question marks with detailed feedback
- Support for multi-page PDF uploads and batch processing
- Handling of varied handwriting styles and scan qualities
- Secure storage and handling of uploaded documents
- Compatibility with standard web browsers and devices

These requirements guided the development of a **user-friendly, AI-powered, and secure digital marking platform** that improves accuracy, efficiency, and transparency in academic evaluation.

2. Designing the System:
The Digimark system is architected for scalability, high performance, and seamless accessibility across multiple devices. The front-end is developed using React, HTML, CSS, and JavaScript, providing an interactive interface for uploading answer sheets, configuring evaluation parameters, and viewing real-time results. This dynamic interface ensures a smooth and intuitive user experience for teachers, evaluators, and administrators.

On the back-end, a secure Flask (Python) environment processes answer sheets using a hybrid AI pipeline consisting of:

- OpenCV-based image preprocessing to enhance scanned answer sheets and improve OCR accuracy
- Tesseract OCR for efficient handwritten text extraction
- NLP processing with NLTK and WordNet lemmatization for semantic analysis and keyword-based evaluation
- Automated scoring algorithms to assign per-question marks and generate detailed feedback To guarantee strong data security and integrity, the system employs:
- Role-based authentication to restrict access to teachers, admins, and evaluators
- Secure file handling and input validation to prevent data corruption or unauthorized access
- SQLite database for storing user profiles, answer sheet metadata, evaluation history, and generated reports

This design ensures that Digimark is efficient, accurate, secure, and user-friendly, enabling large-scale, automated evaluation of handwritten answer sheets while maintaining data privacy and consistent marking standards.

3. Developing the Web Application:
The Digimark platform was developed using open-source technologies:

- Front-End: HTML, CSS, JavaScript, and Bootstrap were used to create responsive pages for file upload, evaluation results, and report download.
- Back-End: Flask handles API requests, file validation, OCR processing, NLP evaluation, and scoring logic.
- AI Features: OpenCV preprocesses images, Tesseract OCR extracts handwritten text, NLP modules analyze and normalize answers, and the evaluation engine assigns marks based on semantic relevance.
- Report Generation: FPDF is used to generate downloadable PDF evaluation reports containing per-question marks and feedback.

The system includes interfaces for uploading answer sheets, viewing evaluation results, and downloading detailed reports. By automating the complete evaluation workflow, Digimark significantly reduces manual effort and ensures consistent and accurate assessment.

"This work is licensed under a Creative Commons Attribution 4.0 International License."
License url: https://creativecommons.org/licenses/by/4.0

International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Vaolume 13, Issue 12, December-2025, Available online at: www.ijaresm.com

IMPLEMENTATION

The website comprisesse veral modules:

- **Home Page:**

The Home Page of the Digital Marking for Scanned Answer Sheets system serves as the central entrypoint for users, offering a clean, intuitive, and user-friendlyinterface. It provides quick access to all major functionalities such as uploading answer sheets, viewing results, accessing the dashboard, and managing user accounts. The layout is designed with simplicity and clarity in mind, ensuring that teachers, evaluators, and administrators can easily navigate the system without technical difficulty. The Home Page prominently features a secure login section that validates the user's role— teacher, admin, or evaluator—before granting access to the core functionalities. A brief overview of the system is displayed to introduce users to key features like automated OCR extraction, AI-based evaluation, and result generation.

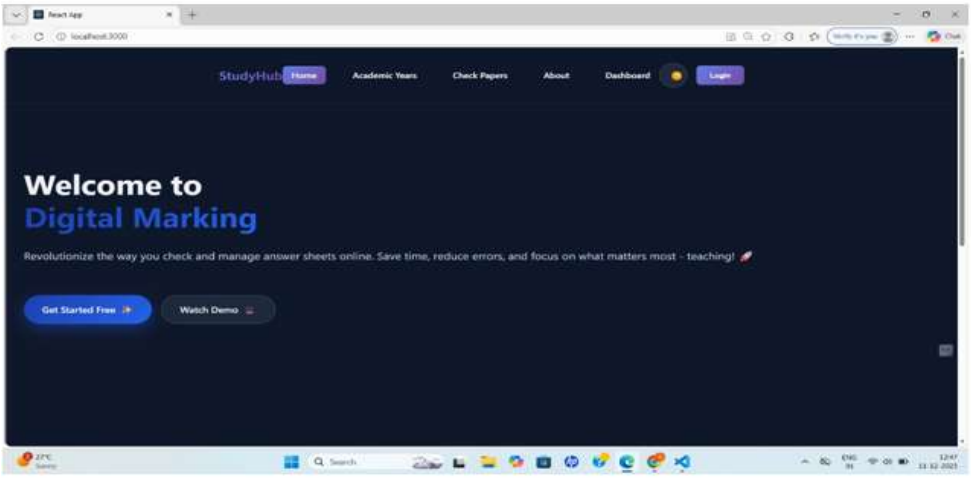

Fig 1 : Home Page

- **Academic Years Page:**

The Academic Years Page provides an organized and user-friendly interface for navigating different academic years in the digital marking system. It displays four visually distinct cards representing 1st Year, 2nd Year, 3rd Year, and Final Year with a modern and clean UI. Each card allows users to access semester-wise subjects with brief academic details. This page serves as a key navigation point before proceeding to subject selection and answer sheet evaluation.

Fig.2:Academic Years Page

"This work is licensed under a Creative Commons Attribution 4.0 International License."
License url: https://creativecommons.org/licenses/by/4.0

International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Vaolume 13, Issue 12, December-2025, Available online at: www.ijaresm.com

• Check PaperPage:

The Check Papers Page is a core module that enables automated answer sheet evaluation using OCR and AI. It allows users to enter student details such as roll number, academic year, and class for proper identification. Users can select the answer type configuration to match subject requirements. The page also supports uploading the question paper, model answer, and student answer PDFs, with an option to initiate evaluation through a single action.

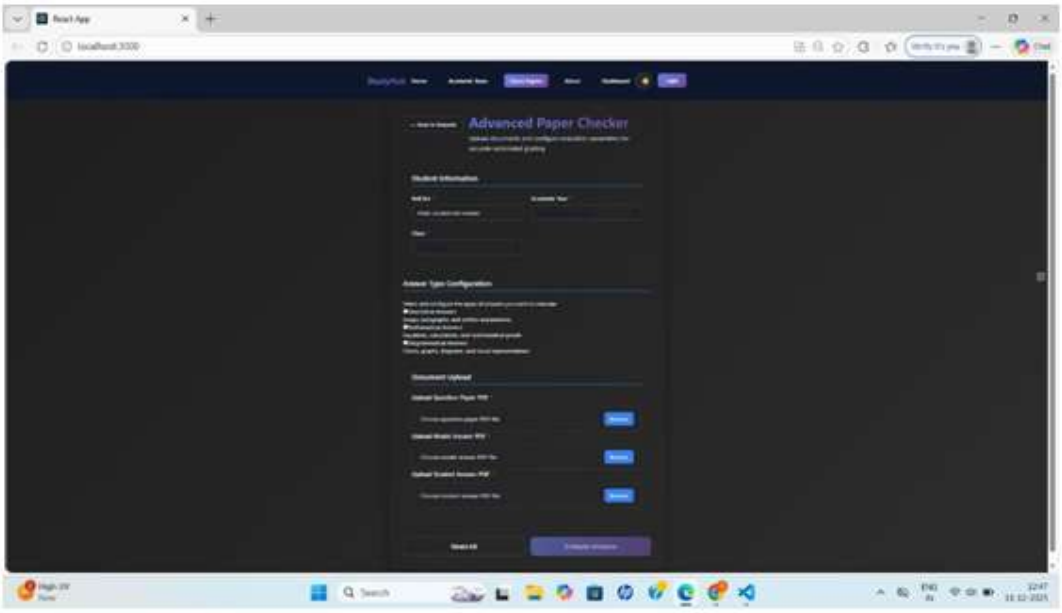

Fig.3:Check PaperPage

• AboutPage:

The About Page explains the advantages of the digital paper-checking system over manual evaluation, highlighting fast AI-based checking and high accuracy. It showcases detailed analytics, secure data encryption, and privacy protection for student information. The page also emphasizes AI-powered improvement and mobile-friendly access across all devices.

Fig 4 : About Page

"This work is licensed under a Creative Commons Attribution 4.0 International License."
License url: https://creativecommons.org/licenses/by/4.0

International Journal of All Research Education and Scientific Methods (IJARESM),
ISSN: 2455-6211, Vaolume 13, Issue 12, December-2025, Available online at: www.ijaresm.com

• **DashboardPage:**
The Dashboard Page serves as the central control panel, displaying key evaluation details in a clear and organized manner. It provides summary cards showing total evaluations, average student performance, and active filters. Users can easily filter records by academic year, class, or subject for quick and efficient analysis.

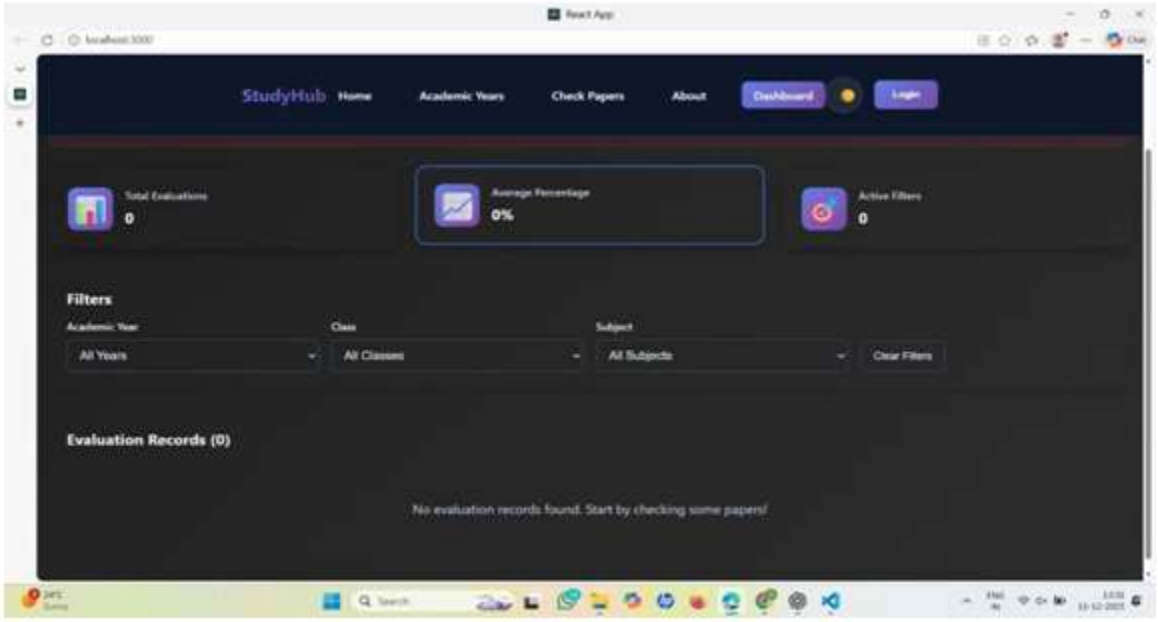

Fig 5 : Dashboard Page

• **LoginPage:**
The Login Page provides a clean and user-friendly interface for accessing the system using a registered email and password. Users enter their credentials in a simple login form and click the Login button to access the dashboard and system features. Invalid credentials are restricted from access, ensuring security. A Register link is also provided for new users to create an account.

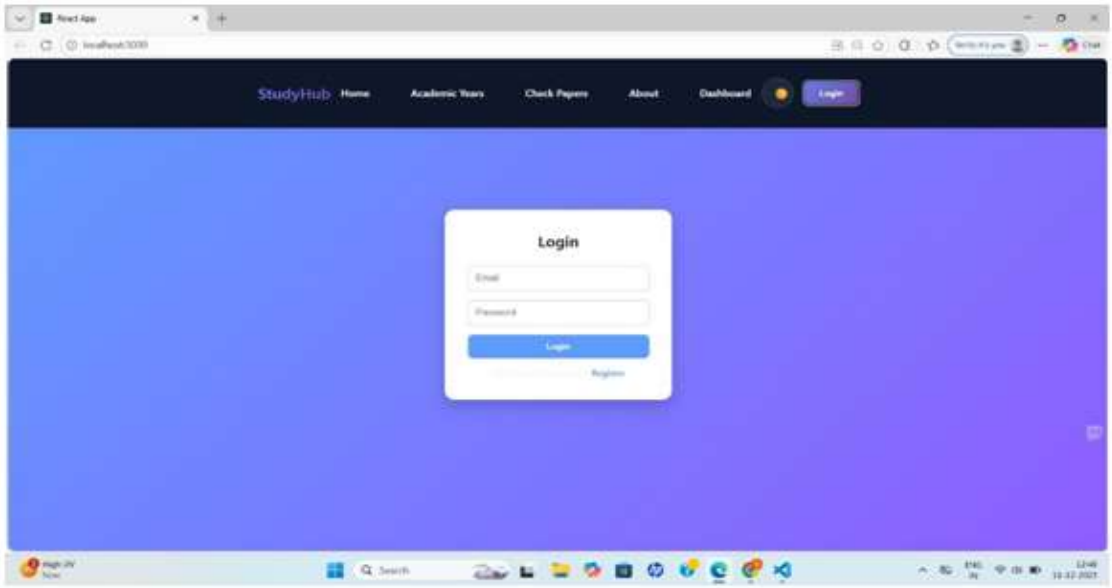

Fig 6 : Login Page

"This work is licensed under a Creative Commons Attribution 4.0 International License."
License url: https://creativecommons.org/licenses/by/4.0

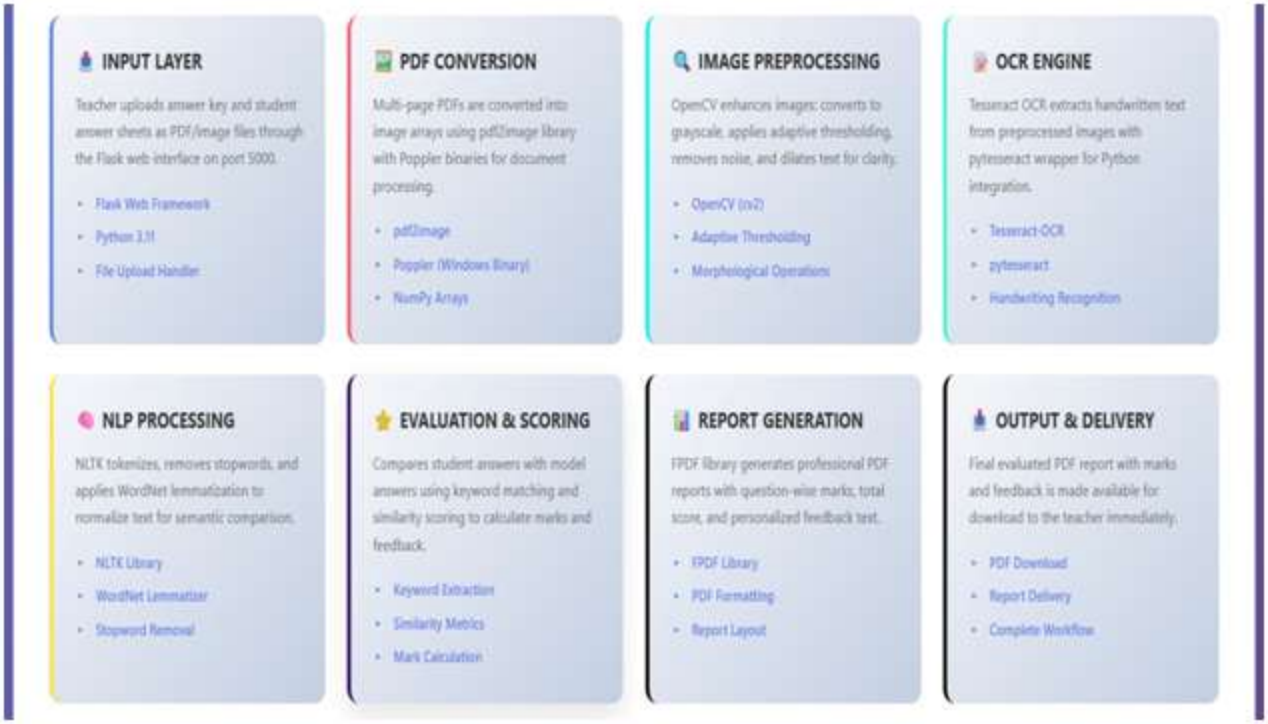

Fig7: FlowChart

Challenges And Future Enhancements

Data Privacy and Security - Digimark handles sensitive academic data such as student answer sheets and evaluation results, making data privacy and security a critical concern. The current system ensures secure file handling and controlled access to evaluation reports. However, future enhancements will focus on stronger encryption mechanisms, role-based access control, and secure cloud storage integration. Additional measures such as audit logs and compliance with educational data protection standards can further enhance system security.

Handwriting Variability and OCR Accuracy - One of the major challenges is the wide variation in handwriting styles, ink quality, and scanning resolution. Poor-quality scans and complex handwriting can reduce OCR accuracy. Future versions of Digimark will integrate advanced handwriting recognition models, including deep learning–based OCR, to improve recognition accuracy across diverse handwriting styles.

Multilingual and Subject-Specific Support - Currently, Digimark primarily focuses on English-language answer sheets. To support a broader academic audience, future enhancements will include multilingual OCR and NLP support for regional and international languages. Subject-specific evaluation models can also be developed to handle technical, mathematical, and domain-specific answers more effectively.

Semantic Evaluation Enhancement - The current keyword-based evaluation approach may not fully capture the depth and meaning of descriptive answers. Future improvements will incorporate semantic similarity models, such as word embeddings and transformer-based language models, to enable more accurate and context-aware answer evaluation.

Real-Time Processing and Scalability - While Digimark supports batch processing, handling very large volumes of answer sheets simultaneously can impact performance. Future iterations will optimize processing through parallel execution, cloud-based deployment, and GPU acceleration, enabling faster real-time evaluation during large-scale examinations.

ExpandingApplications:

Futureusesinclude:

• Institution-Wide Deployment: Integration with college and university examination systems.

• Online Examination Support: Automated evaluation for hybrid and remote exams.

"This work is licensed under a Creative Commons Attribution 4.0 International License."
License url: https://creativecommons.org/licenses/by/4.0

• Educational Analytics: Providing insights into student performance trends and learning gaps.
• Teacher Assistance Tools: Suggesting feedback and grading patterns to educators.

CONCLUSION

The Digital Marking System developed in this project demonstrates how modern technology can effectively enhance the traditional answer evaluation process. By integrating OCR, automated validation, secure data handling, and a user-friendly dashboard, the system significantly reduces manual workload, minimizes human errors, and ensures faster and more consistent assessment of student submissions. The combination of automation with supervised human review improves both accuracy and reliability compared to conventional paper-based evaluation.

Overall, this project shows that digital marking is not merely a technological upgrade but a practical solution to the limitations of manual grading. Features such as valid PDF handling, roll number recognition, efficient text extraction, and organized result display ensure transparency and integrity in the evaluation process. The system also provides a strong foundation for future enhancements, including advanced machine learning–based evaluation, improved security, and large-scale deployment across academic institutions.

REFERENCES

[1]. Han, J., Kamber, M., & Pei, J., Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, 3rd Edition, 2012.
[2]. Mitchell,T.M.,MachineLearning,McGraw-HillEducation,1stEdition,1997.
[3]. Alpaydin,E.,IntroductiontoMachineLearning,MITPress,4thEdition,2020.
[4]. Russell, S. J., & Norvig, P., Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2020.
[5]. Bishop, C. M., Pattern Recognition and Machine Learning, Springer, 1st Edition, 2006.
[6]. Aggarwal,C.C.,DataMining:TheTextbook,Springer,1stEdition,2015.
[7]. Géron,A.,Hands-OnMachineLearningwithScikit-Learn,Keras,and TensorFlow, O'Reilly Media, 2nd Edition, 2019.

"This work is licensed under a Creative Commons Attribution 4.0 International License."
License url: https://creativecommons.org/licenses/by/4.0