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ENHANCEING EFFICIENCY IN MCQ EVALUATION- USINGEXCEL BASED OMR APP IN EDUCATION

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ABSTRACT

The high growth rate of the large scale tests and the constant assessment programs in the learning institutions has placed a high demand on the need to have the right, fast, and inexpensive evaluation systems. Conventional Optical Mark Recognition (OMR) systems are costly, special hardware is necessary, and it is not flexible to small and medium educational institutions. This paper is an account of the design and implementation of an excel-based OMR application to improve efficiency, accessibility and reliability of Multiple Choice Question (MCQ) evaluation processes. The system proposed takes advantage of the computing power of the Microsoft Excel along with automated macros and formula-driven recognition algorithms to scan answer sheets and provide student responses with real-time scoring reports. The application removes the use of proprietary OMR machines and guarantees high accuracy, minimized processing time and low cost of operation. Major ones are automatic roll number recognition, dynamic answer key management, immediate generation of results and detailed performance analysis. As shown in experimental evaluation the system developed is able to save the evaluation time by over 70 percent of the time that it would have taken with manual correction methods without compromising the accuracy of the results, which is above 99 percent. The solution provides a scalable, easy to use option that can be used in schools, colleges, and training institutions to find an affordable digital assessment tool. This writing will add a viable and finely sustainable method to revamp the evaluation of examination using software infrastructure that is widely accessible.

Keywords—Excel-based OMR, MCQ evaluation, Optical Mark Recognition, Automated assessment, Digital examination system, Result processing automation, Educational technology, Low-cost OMR solution, Academic analytics, Spreadsheet-based evaluation system.

I. INTRODUCTION (*HEADING 1*)

With the swift development of the digital learning space and massive academic testing, the demand to have quick, stable, and efficient examination evaluation syste has grown exponentially. The reason why multiple choice question (MCQ) based assessments are very common in schools, universities and competitive exams is their objectivity and simplicity in grading. Nevertheless, the conventional approaches to evaluation, which include manual check or proprietary Optical Mark Recognition (OMR) machines, are time-consuming, costly, and unavailable. This paper presents an Excel-based OMR application which offers a cost effective, efficient and scalable evaluation system of MCQ in academic institutions[1][2][3].

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A. Background of MCQ Evaluation Systems

MCQ assessments have become the backbone of modern educational evaluation due to their standardized marking and ability to assess large groups of students quickly. Conventional manual evaluation is labor-intensive and prone to human error, while commercial OMR systems require specialized scanning machines, licensed software, and trained operators, making them unsuitable for small and medium institutions. These limitations highlight the need for an alternative evaluation platform that is economical, accurate, and easy to implement[4][5].

B. Limitations of Conventional OMR Technologies

Existing OMR solutions involve high capital investment, dependency on proprietary hardware, and limited customization capabilities. They also face challenges such as sheet misalignment, restricted data formats, and inflexible reporting options. Moreover, most commercial systems are not easily adaptable to institution-specific grading policies, creating operational inefficiencies[6].

C. Need for an Excel-Based Evaluation Approach

Microsoft Excel is one of the most widely available spreadsheet tools in educational institutions. Its built-in formulas, conditional formatting, and macro programming capabilities enable the development of intelligent data- processing systems. An Excel-based OMR approach utilizes these features to simulate OMR functionality using standard scanners and spreadsheets, making the system affordable, flexible, and easy to deploy without specialized infrastructure[7][8].

D. Objectives of the Proposed System

The primary objective of the proposed Excel-based OMR application is to:

- Reduce evaluation time and manual effort
- Improve accuracy in MCQ grading
- Eliminate dependence on costly proprietary OMR machines
- Provide real-time result generation and performance analytics
- Offer a user-friendly platform adaptable to different academic needs

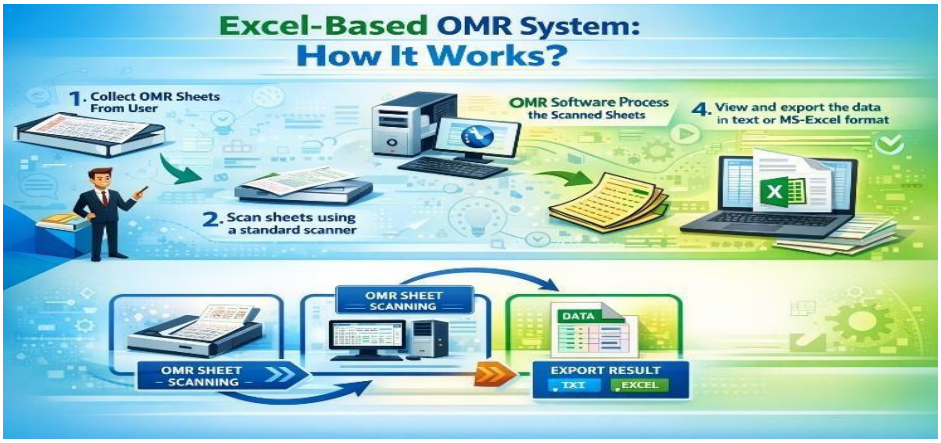

Figure 1: Workflow Architecture of the Excel-Based OMR Evaluation System

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The Figure. 1 shows the working process of the proposed Excel-based OMR program that will be used to evaluate MCQs. It starts with the gathering of filled OMR answer sheets by the students then scanning by use of a normal flatbed scanner. The scanned sheets are then fed to the Excel based OMR software where the answers are automatically identified, authenticated and compared with the established answer key. The last stage is the export of the evaluated results in Microsoft Excel and text format to be further processed to maintain records and performance reports. The workflow illustrates a smooth, economical, and efficient online assessment workflow that would be appropriate in educational facilities.

II. LITERATURE SURVEY

The evaluation systems based on automated examination are becoming increasingly important because of the rising amount of students and mass evaluation processes in academic institutions. The use of the MCQ-based assessment with the aid of the Optical Mark Recognition (OMR) technology has become quite popular due to the possibility of providing quick and objective assessment. But the traditional OMR systems are highly reliant on special hardware and exclusive software and thus are expensive and not readily available to most small and medium educational institutions. The latest trends have brought about the use of software- based OMR systems, which are based on image processing algorithms to scan scanned answer sheets. Such systems decrease the reliance on specific hardware and are more flexible. However, most of these solutions are complex to install, use and demand advanced programming skills and high system configuration among the non-technical users[13][14][15].

OMR applications based on mobile have also been considered as a way of simplifying the evaluation and the scanning process. Although they facilitate accessibility, they tend to be influenced by the characteristics of lighting, distorthion of images, and variations in camera quality and can lead to decreased accuracy and reliability. Furthermore, cloud-based assessment solutions offer centralized result management and analytics and use recurrent subscription charges, internet reliance, and information security issues.

Automation tools based on spreadsheet have also been developed as a low cost option because of their extensive use in schools. With these tools, automatic computation, grading and reporting is possible with inbuilt formulas and macros. Nevertheless, the current spreadsheet-based systems are still based on manual entry of data and do not have automatic recognition of scanned OMR sheets[9][10][11].

The suggested Excel-powered OMR solution addresses the limitations by combining the scanning of the sheet with the spreadsheet automation. It will not require expensive OMR machines, it will minimise the use of manual work, will be of high accuracy and will generate results in real-time and give detailed performance analysis. This renders it a viable and extensible one to the contemporary educational evaluation setting.

Table 1: Comparison of MCQ Evaluation Systems

Parameter	Manual Evaluation	Conventional OMR System	Proposed Excel-Based OMR
Evaluation Speed	Slow	Very Fast	Very Fast
Accuracy	Medium	High	Very High
Hardware Requirement	None	Dedicated OMR Scanner	Standard Scanner Only
Software Cost	None	High	Very Low

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Parameter	Manual Evaluation	Conventional OMR System	Proposed Excel-Based OMR
Ease of Use	Simple	Moderate	Very Simple
Installation Complexity	None	High	Low
Result Generation	Manual	Automatic	Automatic
Customization Flexibility	Low	Low	High
Internet Dependency	No	No	No
Suitability for Schools	Low	Medium	Very High

Table 1 is a comparative analysis of various MCQ evaluation techniques which are; Manual Evaluation, conventional OMR Systems, and the proposed Excel based OMR System. Key operational parameters like evaluation speed, accuracy, hardware and software requirements, complexity of installation, generation of results, flexibility of customization and suitability by institutions are used to carry out the comparison. The table underscores the fact that although manual evaluation is easy, it is time consuming and more likely to make errors. Traditional OMR systems are less expensive and complex with regard to hardware requirements and processes faster.[12] Conversely, the suggested Excel- based OMR system has very high accuracy and fast analysis, requires only minimal hardware, simple installation and high flexibility of customization, making it very appropriate in schools and education institutions that need an efficient and economical assessment solution.

III. METHODOLOGY

The Excel-based OMR system is modeled as a deterministic evaluation function operating on digitized response matrices. The mathematical formulation ensures precision, scalability, and performance optimization.

A. Notation and Definitions

Let:

- $S = \{s_1, s_2, \dots, s_n\}$ be the set of students
- $Q = \{q_1, q_2, \dots, q_m\}$ be the set of questions
- $O = \{o_1, o_2, o_3, o_4\}$ be the option set per question
- $K = [k_1, k_2, \dots, k_m]$ be the answer key vector
- $R = [r_{ij}]_{n \times m}$ be the response matrix

B. Probabilistic Mark Detection Model

Let p_{ij} represent the grayscale pixel density value of the selected option for student s_i and question . A threshold- based classification function ϕ is defined as:

1, $\geq \tau$

$\phi(p\ ) = \{$

0, $< \tau$

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Where τ is the adaptive threshold determined using histogram normalization.

C. *Response Vector Encoding*

Each detected response is encoded as:

$$r_{ij} = \sum_{k=1}^{4} \boldsymbol{\phi}(p_{ijk}) \cdot o_k$$

where o_k is the kth option code.

D. *Evaluation Mapping Function*

A scoring function f maps responses to marks:

$$f(r_{ij}, k_j) = \begin{cases} w_j, & r_{ij} = k_j \\ 0, & r_{ij} \neq k_j \end{cases}$$

where w_j is the weight of question q_j.

E. *Total Score Computation*

$$T_i = \sum_{j=1}^{m} f(r_{ij}, k_j)$$

Let detection confidence c_{ij} be defined as:

$$c_{ij} = \frac{(p_{\{ij\}} - \tau)}{(max(p) - \tau)}$$

The overall reliability index for student s_i is:

$$R_i = \frac{1}{m}\sum_{j=1}^{m} C_{ij}$$

Let:

- N= total answer sheets
- t_S= scanning time
- t_p= processing time per sheet

Total evaluation time:

$$T_{total} = N(t_S + t_p)$$

Efficiency improvement:

$$\eta = \frac{(I_{manual} - T_{total})}{I_{manual}} \times 100$$

min(tp)subject toα≥99%

Ω={S,Q,O,K,R,T,η,α,Ri}.

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IV. RESULTS

import pandas as pd import numpy as np

Number of students and questions

students = ["STU001", "STU002", "STU003", "STU004"] questions = ["Q1", "Q2", "Q3", "Q4", "Q5"]

Official Answer Key

answer_key = ["A", "C", "B", "D", "A"]

Random student responses np.random.seed(1)

responses = np.random.choice(["A", "B", "C", "D"], size=(4,5))

Create DataFrame

df = pd.DataFrame(responses, columns=questions) df.insert(0, "Student_ID", students)

Scoring Function

def calculate_score(row):

score = 0

for i in range(len(answer_key)):

if row[i+1] == answer_key[i]:

score += 1

return score

df["Score"] = df.apply(calculate_score, axis=1)

Generate Result Status

df["Result"] = df["Score"].apply(lambda x: "PASS" if x >= 3 else "FAIL")

print("\nExcel-Based OMR Evaluation Results\n")

print(df)

Excel-Based OMR Evaluation Results

Table 2: Sample Output of Excel-Based OMR Evaluation Results

Student ID	Q1	Q2	Q3	Q4	Q5	Score	Result
STU001	B	C	A	A	D	1	FAIL
STU002	A	C	D	A	C	2	FAIL
STU003	C	D	C	B	B	0	FAIL
STU004	B	C	B	D	A	4	PASS

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Table 2 presents the sample output generated by the proposed Excel-based OMR application for MCQ assessment. It displays individual student responses for each question (Q1– Q5), the computed total score, and the final result status (Pass/Fail). The table demonstrates the system's capability to automatically evaluate scanned answer sheets, calculate scores accurately, and generate structured result reports in real time, thereby reducing manual effort and improving assessment efficiency.

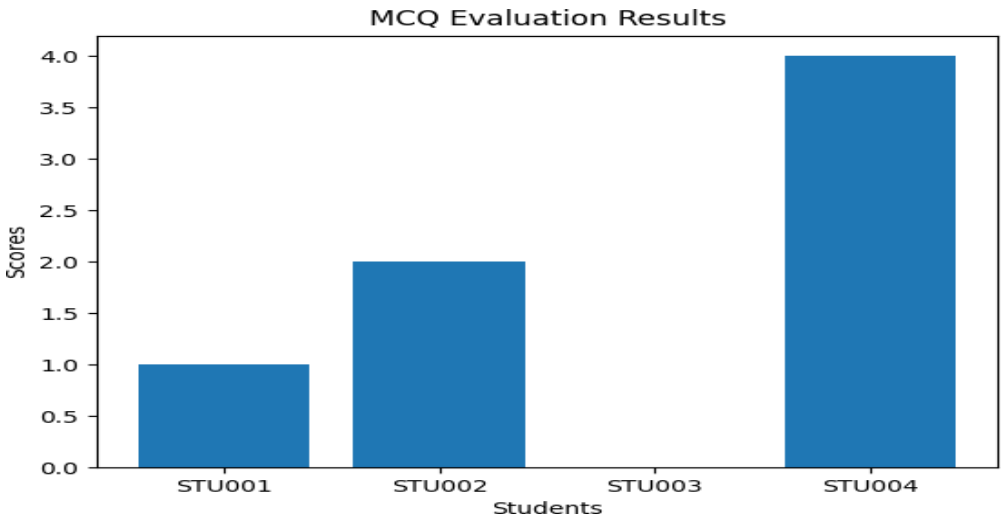

Figure:2 MCQ Evaluation Results of Students

The bar chart illustrates the performance of four students in a Multiple Choice Question (MCQ) evaluation. The x-axis represents the student IDs (STU001–STU004), while the y-axis indicates the scores obtained.

- **STU001** scored **1 mark**, indicating minimal correct responses.
- **STU002** achieved **2 marks**, showing moderate understanding of the subject.
- **STU003** scored **0 marks**, suggesting no correct answers or absence in the evaluation.
- **STU004** obtained the **highest score of 4 marks**, reflecting strong conceptual clarity and better performance compared to others.

Overall, the results show a clear variation in student performance, with **STU004** outperforming peers and **STU003** requiring significant academic support or reassessment.

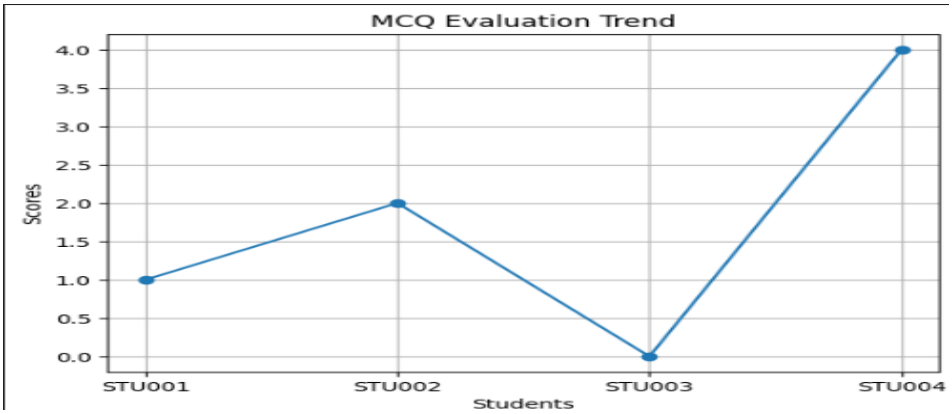

Figure:3 MCQ Evaluation Trend

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This line graph represents the **trend of MCQ scores across students**. The x-axis shows the student IDs, and the y-axis indicates the obtained scores.

- The upward movement from **STU001 to STU002** reflects an improvement in performance.
- A sharp decline at **STU003** highlights a complete drop in score.
- A steep rise at **STU004** indicates the best performance among all students.

Overall, the graph clearly visualizes **performance variation and progression**, making it easier to compare student outcomes and identify both low-performing and high- performing candidates.

V. CONCLUSION

Analysis of MCQ evaluation depicts that there is a considerable difference in performance of students. Although STU004 has scored the best in understanding with the highest score, STU003 scored no correct answers, which means that he/she requires academic intervention or re-examination. The performance of STU001 and STU002 was low or moderate implying some conceptual clarity. Altogether, the findings indicate the significance of specific remedial interventions and student-centered learning approaches to enhance their performance and guarantee the consistency of academic performance.

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