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OMR Automated Grading

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Abstract:- The paper highlights the necessity for a technologically advanced system capable of efficiently grading multiple-choice question (MCQ) exams through webcam-based evaluation. MCQ-style assessments have gained widespread use in educational and organizational settings due to their effectiveness and time-saving advantages. However, manually grading these exams presents significant challenges. Managing a large number of answer sheets in a timely manner is labor-intensive and error-prone, potentially leading to scoring discrepancies. Additionally, the logistical burden of storing and handling physical answer sheets is cumbersome, with risks such as damage from environmental factors like fire or moisture. While larger institutions may utilize specialized Optical Mark Recognition (OMR) technology for grading, smaller educational entities often lack access to such costly equipment. To address these challenges, the paper proposes an innovative solution: leveraging webcam technology to automate the grading process. By capturing images of answer sheets and employing sophisticated content-filtering and image processing algorithms facilitated by the OpenCV library, the system can accurately interpret and evaluate marked answers. Overall, the proposed system represents a significant advancement in exam grading methodology, providing a practical and cost-effective solution to the longstanding challenges associated with manual grading of MCQ-based assessments. By integrating webcam technology into the grading process, the system aims to enhance efficiency and accuracy while catering to the needs of various educational and organizational assessments.

I. INTRODUCTION

The introduction highlights the widespread use of multiple-choice question (MCQ) exams worldwide and their significance in evaluating students' academic abilities. It emphasizes the prevalence of MCQ formats in prominent exams such as K-CET, NEET, and also in international assessments like TOEFL, GRE, and GMAT, owing to their time-saving nature and streamlined evaluation processes. However, traditional grading methods facing challenges mainly in such institutions which have lack access to advanced scanning equipment, leading to time-consuming manual grading processes, particularly with large numbers of test-takers. To address these challenges, the paper proposes a novel solution utilizing the built-in webcams of laptops for OMR, aiming to democratize access to automated grading processes while reducing costs. By capturing and processing images of answer sheets using content filtration and image processing algorithms, the system aims to revolutionize assessment methods, ensuring efficiency and accuracy without using expensive hardware or software. Additionally, the system's algorithm is made to find standardized answer sheet formats, ensuring compatibility across various exam layouts and educational settings.

Moreover, OMR grading technology is expected to alleviate the inefficiencies and inaccuracies of manual grading, enhancing the educational assessment ecosystem. By automating the recognition and interpretation of marked responses, educators can redirect their focus towards refining instructional methodologies, engaging with students, and pursuingprofessional development opportunities. Additionally, the system's scalability ensures seamless handling of diverse question formats and extensive surveys or examinations, catering to the evolving demands of educational institutions worldwide.

The scalability of the proposed system extends beyond volume management to encompass quicker turnaround times in the gradingcycle, facilitating timely feedback to students and supporting theiracademic growth by promptly addressing any misconceptions or knowledge gaps. Furthermore, the addition of OMR technology fosters a standardized and consistent grading approach, minimizing variations that may arise in manual grading and promoting fairness and impartiality in evaluations. The automation of response processing not only optimizes workflow efficiencies but also contributes to the establishment of a reliable and transparent evaluation system.

Educators stand to gain significantly from embracing OMR technology, benefiting from reduced errors and increased scalability. Overall, OMR technology signifies a notable advancement in educational assessment methods, transforming grading practices and promoting a more effective, fair, and student-centered learning environment. The paper stresses the importance of innovative solutions to overcome from the problems associated with traditional grading methods and highlights the proposed system's capability to simplify grading procedures while reducing expenses and resource demands. Through sophisticated content filtration and image processing algorithms, the system accurately captures and assesses

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responses from MCQ answer sheets, catering to diverse institutional requirements worldwide.

The paper emphasizes the critical necessity for creative solutions to address the challenges linked with conventional grading methodologies. Through the implementation of sophisticated content filtration and image processing algorithms, the system ensures the accurate capture and assessment of responses from multiple-choice question (MCQ) answer sheets. This capability makes the system adaptable to diverse institutional requirements worldwide, catering to various exam formats and educational contexts.

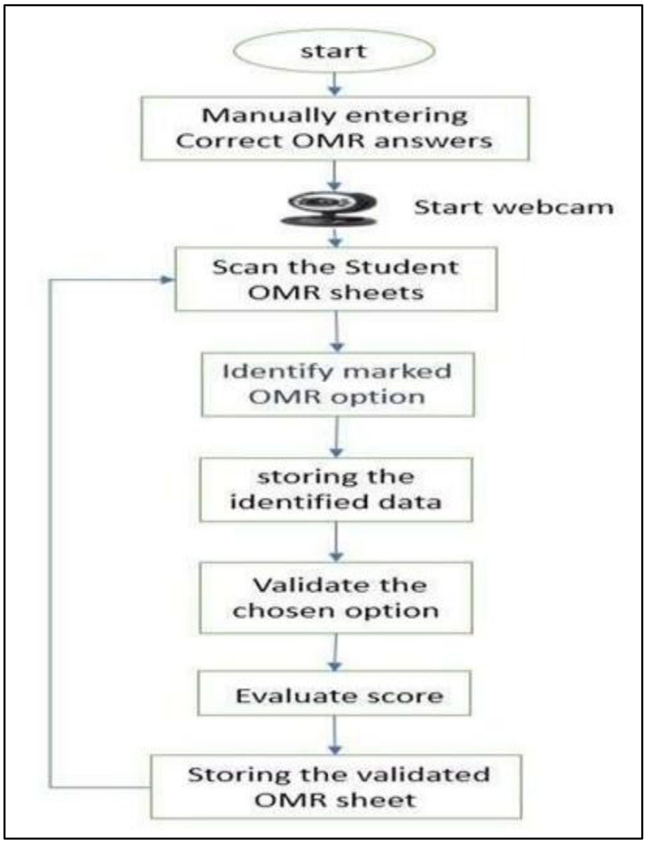

Fig 1: Application Flow

A. Manually Entering Correct OMR Answers:

Prepare an answer key with the accurate responses before scanning the OMR sheets. The answer key serves as a reference for comparing scanned responses during evaluation, ensuring grading accuracy.

B. Start Webcam:

Activate the webcam hardware on the computer or device to initiate the scanning process. Webcam activation enables the device to capture images of filled OMR sheets for subsequent processing. Scan the Student OMR Sheets: Place the filled OMR sheet under the webcam's view for scanning. The webcam captures an image of the sheet, which is processed by the OMR software.

C. Identify Marked OMR Option:

The software analyzes the scanned image to identify marked responses made by the student. It detects darkened bubbles or checkboxes corresponding to selected options on the OMR sheet.

D. Storing the Identified Data:

Store the recognized data, comprising student identification particulars and chosen responses for each query. The retention of this data enables analysis, reporting, and feedback generation centered on student performance.

E. Validate the Chosen Option:

Compare the student's responses with correct answers from the answer key. Validated responses contribute to the student's score, while discrepancies are flagged for review. This step is used to ensuring fairness and accuracy in grading, as it helps identify and rectify any errors or inconsistencies in the evaluation process.

F. Evaluate Score:

Based on validation, calculate the student's OMR test scores. Correct answers add to final score, while incorrect responses may result in deductions.

G. Storing the Validated OMR Sheet:

Store the validated OMR sheet, along with the score and metadata, for future reference. Archived sheets can be accessed for analysis, review, or record- keeping purposes.

II. ALGORITHM AND IMPLEMENTATION

- **Median Filtering:** Median filtering is a widely employed method in image processing aimed at enhancing the quality of images by reducing noise. It achieves this by calculating pixel values based on the median value of neighboring pixels in its vicinity. This technique efficiently reduces sudden pixel value variations due to noise, leading to clearer and aesthetically improved images.
- **Conversion to Grayscale:** RGB, an acronym for red, green, and blue, is a color representation system commonly used in digital screens to create wide range of colors. Converting to grayscale entails changing an image's RGB format to a single-channel grayscale format, with each pixel represented by an intensity value spanning from black to white. This conversion removes color information, resulting in a monochromatic image that emphasizes luminance and simplifies subsequent image processing tasks.
- **Edge Detection:** Edge detection is a fundamental which helps in identifying the boundaries or edges of objects in an image. By detecting abrupt changes in pixel intensity, edge detection algorithms highlight regions of significant contrast, which typically correspond to object boundaries. This step plays a crucial role in a range of applications such as object detection, image segmentation, and feature extraction. It enables the identification and delineation of

objects or details within images, paving the way for deeper analysis and interpretation.

- **Complementation of the Image:** The complement of an image alters its brightness by reversing the intensity values of each pixel. Dark color portion of the image become lighter, while light areas become darker. This conversion plays a vital role in adjusting the image's contrast and dynamic range, thereby improving its visual appeal and simplifying subsequent image processing tasks. Through intensity value inversion, the complement operation reveals obscured details caused by extreme brightness or darkness in the original image, enhancing its clarity and overall quality.
- **Thresholding**: Thresholding simplifies images by converting them into binary form using a specified threshold value. Pixels above the threshold are categorized as one type, while those below it are categorized differently. This method aids in focusing on specific details within the image and is widely used in applications like image segmentation and object detection.
- **Canny Edge Detection Algorithm:** The Canny edge detection algorithm stands as a foundational tool in computer vision and image processing, renowned for its precision and effectiveness in edge detection. Conceived by John F. Canny in 1986, the algorithm begins by converting the image from RGB to grayscale, streamlining the edge detection process. It employs various methods such as Gaussian smoothing to diminish noise, computes gradients to determine edge strength and orientation, and performs non-maximum suppression to refine detected edges.

and hysteresis thresholding to link adjacent edge pixels. By combining these techniques, the Canny algorithm can accurately detect and localize edges while minimizing false detections and noise artifacts, making it a vital tool in various image analysis and computer vision applications.

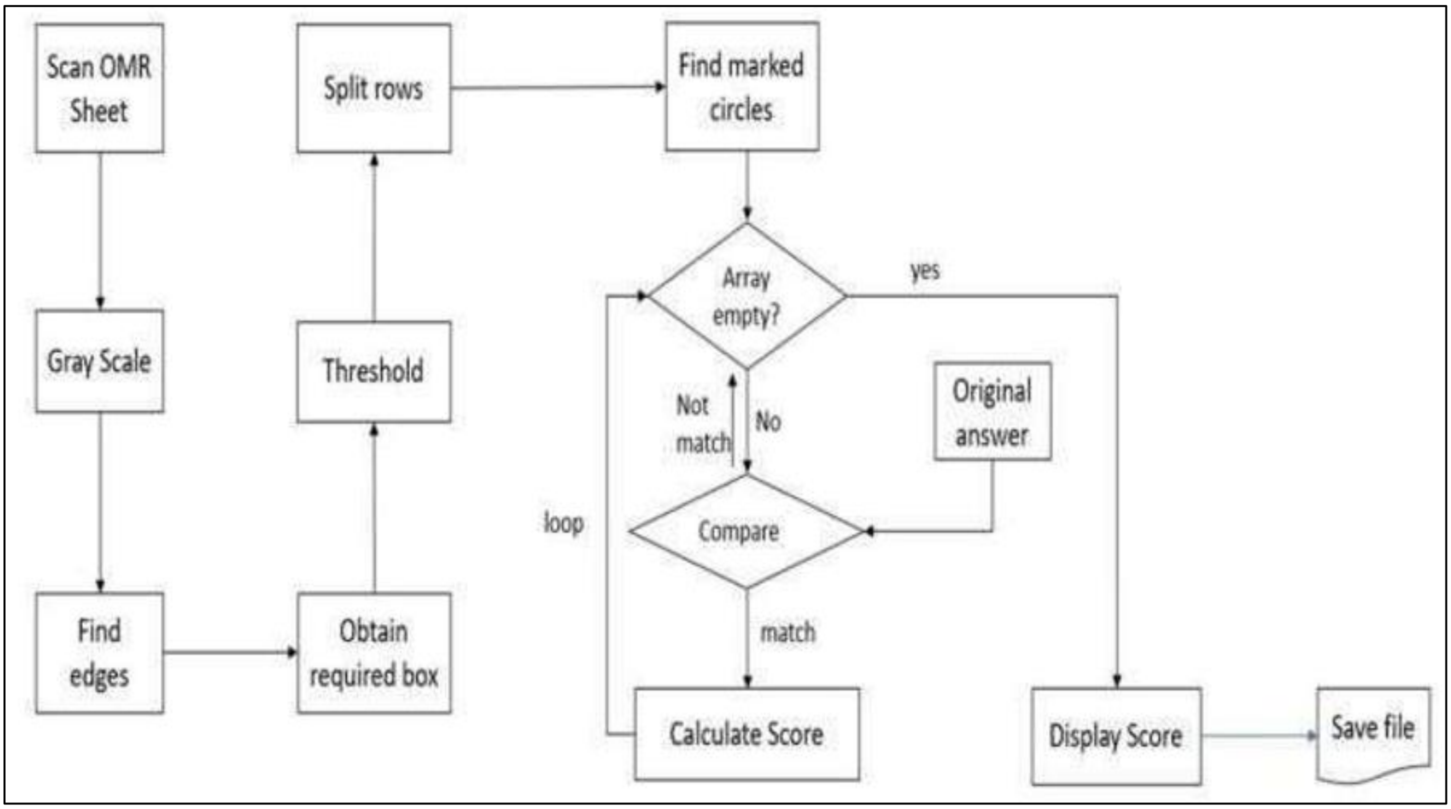

Fig 2: Flow Chart

- **Scan OMR Sheet:** The OMR sheet, filled out by the student, isscanned using an optical scanner or imaging device. This processconverts the physical sheet into a image file.
- **Grayscale Conversion:** The scanned image is converted fromcolor to grayscale. Grayscale images represent pixel intensities using shades of gray, simplifying subsequent image processing steps while retaining essential information for analysis.
- **Find Edges:** Algorithms for edge detection are utilized on the grayscale image to outline the boundaries of circles marked on the OMR sheet, denoting the areas filled by the student.
- **Defining Boxes:** Using the identified edges, bounding boxes are established around each marked circle to isolate and concentrate on these specific regions, aiding in further analysis.

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- **Thresholding:** Employing a thresholding technique on the grayscale image converts it into binary form, categorizing pixels as black or white based on a defined threshold. This step segregates marked circles from background elements or shadows, enhancing clarity.
- **Split Rows:** The binary image is segmented into distinct rows, representing different sections or questions on the answer sheet. This segmentation organizes the data for focused processing, allowing examination of individual rows sequentially.
- **Find Marked Circles:** Each row in the binary image undergoes analysis to identify marked circles, indicating the student's selected answers. This detection process involves pinpointing filled circles within the previously established bounding boxes.
- **Check Student Answered:** The system checks whether the student has answered any questions on the sheet. If questions are marked, the system compares the marked array with the original array to identify which questions have been answered.
- **Compare:** The marked responses on the sheet undergo comparison with the corresponding answers from the answer key, establishing the correctness of each student-selected answer.
- **Calculate Score:** Using the comparison outcomes, the system calculates the student's score by tallying the number of correct answers and assigning points accordingly.
- **Display Score:** The system displays the student's score, providing feedback on their performance by showcasing the total correct answers and the resulting overall score. Lastly, the student's answer sheet and score are saved as a file for archival and future analysis. This storage enables ongoing tracking and referencing of student progress and performance trends.

III. RESULT

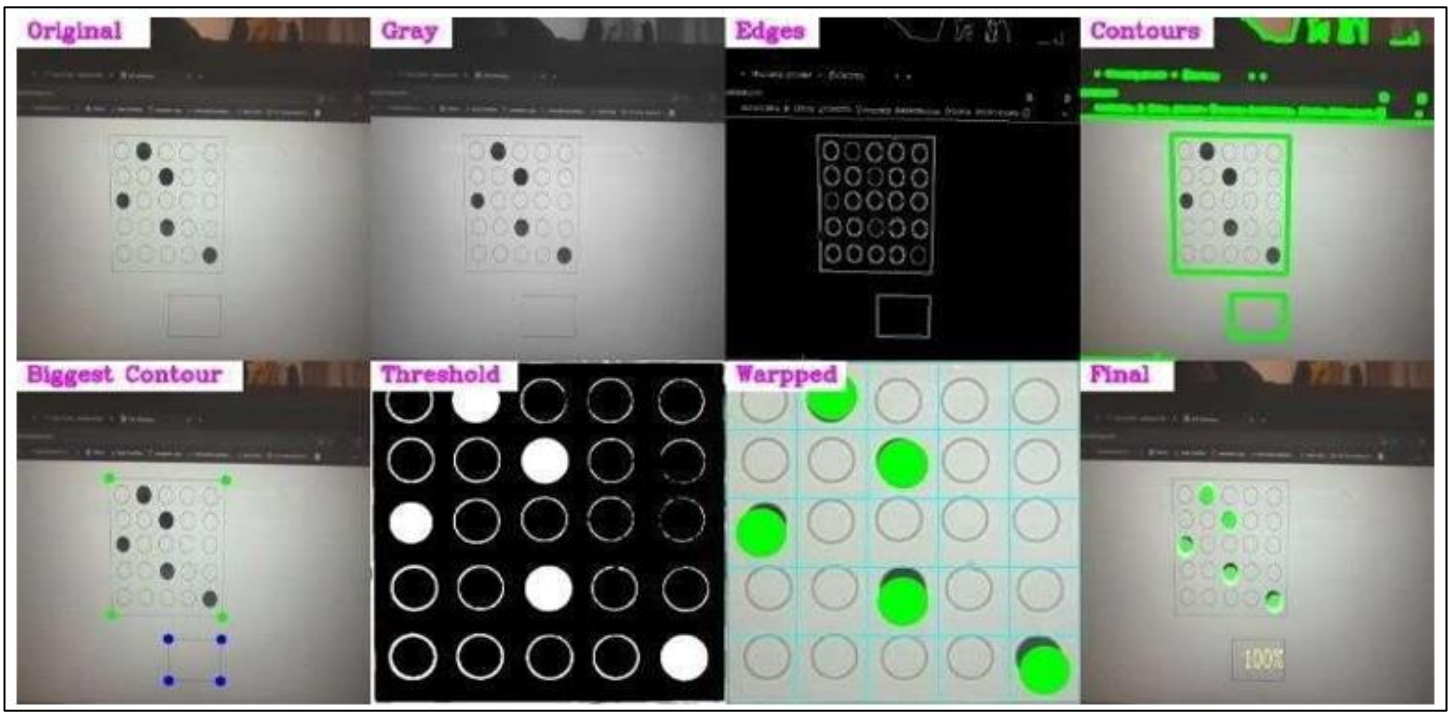

Fig 3: Result

- **Original:** This image represents the original input image loaded from a file.
- **Gray:** After capturing the original image, it's converted to grayscale. Grayscale images have only shades of gray, which simplifies the subsequent image processing steps.
- **Blur:** The grayscale image is then subjected to Gaussian blurring, which helps in reducing noise and unwanted details.
- **Canny:** Canny edge detection is then applied to the blurred image, identifying edges as regions with significant intensity changes, crucial for object outline identification.
- **Contours:** The outlines of objects detected in the Canny edge-detected image are represented as contours, visualized on the original image.
- **Biggest Contour:** The largest contour, usually representing the main object of interest, is identified among all detected contours for next process.

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- **Wrapped:** The largest contour, likely containing the main rectangular region with multiple-choice questions, undergoes a transformation to a rectangular shape for alignment.
- **Threshold:** The warped image is then threshold to segment regions corresponding to filled bubbles in multiple-choice questions, simplifying object identification.
- **Result:** The final result image displays the processed input along with detected answers and grading.
- **Img Raw Drawing:** This image likely shows intermediate processing steps or debugging information, such as drawings on a blank canvas.
- **Inv Wrap:** The inverse warped image is the result of reversing the perspective transformation for overlaying detected answers and grading back onto the original input image.
- **Final:** The final image combines the original input with detected answers and grading, providing a complete view of analysis results.

IV. CONCLUSION

In various applications, such as academic assessments or performance evaluations, grades serve as a standardized method for categorizing marks. For instance, an A grade typically signifies a score above 90, while a B grade may indicate a score above 80. This grading system provides clarity and consistency in evaluating individuals' achievements or proficiency levels across different contexts.

Leveraging the prowess of OpenCV, a powerful open-source computer vision library, ensures precise image processing and grading. OpenCV's sophisticated algorithms enable the system to accurately interpret and analyze scanned answer sheets or images, thereby enhancing the reliability and accuracy of the grading process.

Compared to traditional manual grading methods, which often involve extensive human labor and time-intensive processes, the proposed system offers a more cost-effective solution. By automating the grading process, institutions can substantially cut costs tied to with hiring personnel and investing in specialized grading equipment, resulting in substantial cost savings over time. Furthermore, the versatility of the system extends beyond exams, as it can also be employed for tasks such as surveys and attendance tracking. Its adaptability to various assessment scenarios enhances its utility and value for educational institutions seeking efficient solutions for grading and data collection purposes.

The proposed system represents a significant leap forward in automated grading technology, offering a comprehensive solution that prioritizes efficiency, accuracy, and accessibility. By combining innovative algorithms, and cost-effective implementation, the system addresses longstanding challenges in grading methodologies, paving the way for a more streamlined and equitable assessment process in educational and organizational settings.

V. FUTURE WORKS

In future developments of the automated grading system, several enhancements are proposed to enhance its functionality and usefulness for educators and students alike. Firstly, expanding the system to support grading in multiple languages would accommodate diverse student populations, ensuring fair and accurate grading for all regardless of their language proficiency. This addition would contribute to inclusivity and accessibility in the assessment process.

Secondly, implementing a feature for instant feedback students on their performance would promote continuous learning and improvement. This feature could analyze students responses and provide personalized feedback, helping them identify strengths and areas for improvement promptly.

Additionally, offering cloud storage options for storing evaluated answer sheets addresses concerns related to data security andaccessibility. Cloud storage provides a secure and centralized repository for storing graded answer sheets, ensuring easy access for educators while maintaining data integrity and confidentiality.

Lastly, implementing a feature that offers detailed scores for different sections of the exam further enriches the grading system's capabilities. By providing granular insights into students' performance across various exam sections such as technical areas, coding, and aptitude, This detailed scoring system allows for targeted interventions and personalized support, ultimately contributing to improved learning outcomes.

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