A Survey on OMR Automated Grading System: A Case Study
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This paper introduces an Automated Grading System for Multiple-Choice Surveys, leveraging the power of OpenCV (Open-Source Computer Vision Library). The conventional manual grading methods for surveys often pose challenges in terms of time efficiency and accuracy. The integration of Optical Mark Recognition (OMR) technology has alleviated some of these challenges, but this paper seeks to enhance the grading process further through the incorporation of OpenCV.

The renowned high-level organizations or institutions utilize Optical Mark Recognition (OMR) technology for the efficient assessment of a large number of students, numbering in the millions. The system, designed for accessibility and ease of use, evaluates all the answers, calculates the score and total percentage, and displays the results. Leveraging the ubiquity of laptops, the proposed system eliminates the need for expensive scanners and offers a more accessible solution for educational institutions.

The primary objectives include improving efficiency, minimizing human errors, ensuring scalability for handling large volumes of survey sheets, and integrating advanced technology through OpenCV for robust image processing and pattern student papers, numbering in the millions. This approach is driven by the practicality of manually grading each paper due to the sheer volume of students, coupled with the potential for human errors and biases. Additionally, maintaining physical papers for an extended period poses challenges related to climate-induced damage, and the manual recording of scores in various Excel sheets further compounds the administrative burden. The sophisticated scanners employed by high-level organizations for continuous batch scanning are often beyond the financial reach of regular schools or colleges.

In addressing these challenges, the goal of this project is to develop a system that simplifies the evaluation process. By recognition. This Automated Grading System represents a scalable, accurate, and efficient solution for evaluating multiple-choice surveys, setting a new standard for modern survey-based assessments.

1. Introduction:
   1.1 Background:

Traditional grading methods impose a significant strain on educators, primarily attributed to the time-consuming nature of manual evaluation, especially when confronted with a substantial volume of survey responses. The laborious task of meticulously assessing each response not only consumes valuable time but also introduces the potential for human errors, diminishing the overall efficiency of the grading process. Educators find themselves grappling with an increased workload, often sacrificing valuable time that could be better invested in refining instructional methods, engaging with students, or pursuing professional development opportunities.

In response to these challenges, Optical Mark Recognition (OMR) technology emerges as a transformative solution, offering a paradigm shift in the grading landscape. OMR technology provides an automated and systematic approach to the evaluation process, effectively mitigating the shortcomings of manual grading. By automating the recognition and interpretation of marked responses on OMR sheets, this technology significantly reduces the dependency on labor-intensive grading procedures. The cumbersome and error-prone task of manually deciphering and recording each response is replaced by a streamlined and efficient automated system.

The implementation of OMR technology brings about a notable enhancement in the overall efficiency of the grading process. Educators benefit from the alleviation of the time burden associated with manual grading, allowing them to redirect their focus towards more strategic and impactful aspects of their profession. The potential for human errors is substantially diminished, ensuring a higher degree of accuracy in the assessment of survey responses. This, in turn, contributes to the reliability of the grading outcomes, fostering a more trustworthy evaluation system.

Moreover, the integration of OMR technology introduces an element of scalability, enabling educators to handle a larger volume of survey responses without a proportional increase in the time and effort required. The automated nature of OMR systems allows for the swift processing of numerous responses, thereby catering to the needs of educational institutions dealing with extensive surveys.
or examinations. As a result, educators can manage their responsibilities more effectively, accommodating the growing demand for assessments in educational settings. In conclusion, the adoption of OMR technology represents a pivotal advancement in the realm of educational evaluation. By automating the grading process, educators can overcome the challenges posed by traditional manual methods, experiencing heightened efficiency, reduced errors, and enhanced scalability. This technology not only optimizes the workflow for educators but also contributes to the establishment of a more reliable and streamlined educational assessment ecosystem.

The implementation of OMR technology promotes a more standardized and consistent grading approach. The automated recognition of marked responses ensures uniformity in assessment criteria application, minimizing variations that may arise in manual grading. This standardization contributes to a fair and impartial evaluation process, fostering transparency and equity in the educational system.

Additionally, OMR technology facilitates quicker turnaround times in the grading cycle. The automated system processes responses at a rapid pace, allowing educators to provide timely feedback to students. This swift feedback loop enhances the learning experience by promptly addressing any misconceptions or gaps in understanding, ultimately supporting students' academic growth.

The scalability of OMR technology extends beyond volume handling to accommodate diverse question formats.

**Objectives:**

The proposed Automated Grading System stands as a beacon of efficiency enhancement in the educational evaluation landscape. By harnessing cutting-edge technology, particularly the powerful OpenCV (Open-Source Computer Vision Library), the system aims to revolutionize the grading process. The core focus lies in streamlining the evaluation of marked responses on survey sheets, significantly reducing the time and effort traditionally associated with manual grading methods. This efficiency enhancement not only benefits educators but also promotes a quicker turnaround in providing feedback to students, fostering a dynamic and responsive learning environment.

In tandem with efficiency, the system prioritizes accuracy improvement by leveraging the precise image processing capabilities of OpenCV. This strategic integration minimizes the potential for human errors that may occur in manual grading, ensuring a reliable and meticulous assessment of survey responses. OpenCV's advanced features in image preprocessing, contour detection, and pattern recognition contribute to the system's accuracy, thereby elevating the overall quality of the grading process.

The scalability and adaptability of the system address the evolving needs of educational institutions and organizations. The design focuses on creating a robust infrastructure capable of seamlessly handling a large volume of survey sheets. This scalability ensures that the system remains effective and efficient, even in scenarios involving extensive examinations or surveys, aligning with the diverse requirements of educational assessments.

Furthermore, the integration of OpenCV plays a pivotal role in technology enhancement. Leveraging OpenCV's features, the system employs advanced image preprocessing techniques to optimize the quality of captured images. The contour detection capabilities ensure precise identification of marked responses on survey sheets, while pattern recognition enhances the system's ability to interpret diverse question formats accurately. This technology integration not only improves the grading process but also establishes the Automated Grading System as a sophisticated and adaptive solution for modern educational evaluation.

To provide a comprehensive assessment of students, the system introduces categorization based on percentages. This feature allows students to be categorized as excellent, good, average, or below average, offering a nuanced understanding of their performance. This categorization not only aids educators in providing targeted feedback but also provides students with a clearer picture of their academic standing, fostering a constructive approach towards improvement.

The Automated Grading System represents a holistic approach to educational evaluation, combining efficiency enhancement, accuracy improvement, scalability, technology integration with OpenCV, and insightful categorization. This multifaceted system aims to redefine the grading landscape, offering comprehensive, accurate, and efficient solutions that meet the diverse needs of educational institutions and organizations.

The efficiency enhancement achieved through automation not only saves time for educators but also allows them to allocate their efforts more strategically. Educators can focus on refining instructional content, engaging with students on a deeper level, and tailoring their teaching methods to address specific learning needs. This, in turn, contributes to an enriched educational experience for both educators and students.

The precision offered by OpenCV's image processing capabilities ensures a high level of accuracy in assessing marked responses. This accuracy is crucial in maintaining the integrity of the evaluation process, providing fair and consistent results for all students. The reduction in human errors not only bolsters the reliability of grading outcomes but also instills confidence in students and stakeholders regarding the fairness of the assessment.

Scalability and adaptability are pivotal in accommodating the diverse dynamics of educational institutions. The system's capability to seamlessly handle large volumes of survey sheets is a testament to its scalability, making it an invaluable tool for education.
educational organizations dealing with varying magnitudes of assessments. The adaptability of the system ensures its relevance across different educational settings, from small classrooms to large-scale examinations.

The integration of OpenCV's features for image preprocessing, contour detection, and pattern recognition aligns with the technological advancements shaping modern education. By staying at the forefront of technological innovation, the Automated Grading System not only meets the current needs of educational evaluation but also positions itself as a forward-thinking solution ready to evolve with future technological trends.

Categorizing students based on percentages adds a layer of granularity to the evaluation process, providing educators with nuanced insights into individual performance levels. This categorization system facilitates targeted interventions, allowing educators to tailor support and guidance based on students' specific academic standings. It fosters a personalized approach to education, recognizing and addressing the unique needs of each student.

2. Related Work:
    The OMR-Based Grading System for Academic Institutions represents a groundbreaking shift in the traditional grading paradigm, utilizing Optical Mark Recognition (OMR) technology through widely available scanners. This system introduces a cost-effective and automated solution for academic institutions, particularly inspired by the imperative for affordable automation in school contests. By implementing image processing techniques on mobile devices, the system streamlines the grading of student response sheets, achieving a commendable recognition success rate of 97.6%. Notably, it offers key features such as the generation of default lists with a simple button push, catering to the efficiency needs of academic institutions, particularly in large-scale assessments like surveys and questionnaires.

While the OMR-Based Grading System excels in various scenarios, it acknowledges limitations, particularly within accurately printed or thin materials. However, the overall error rate remains impressively low, standing below 1.5%. This system emerges as a cost-effective and viable solution, demonstrating adaptability to the specific needs of academic institutions, especially in scenarios where budget constraints are a consideration.

In contrast, the Camera-Based Grading System for Multiple-Choice Tests presents an innovative and novel approach to grading, leveraging cameras for enhanced efficiency and reliability. The methodology incorporates advanced techniques such as the Hough transform for image allocation, skew correction, and normalization. The recognition of tick marks is facilitated by a masking technique, surpassing traditional OMR methods with significantly improved accuracy, reliability, and reduced elapsed time. Notably, this system showcases cost-efficiency by achieving high accuracy even with lower-cost non-transoptic answer sheets, addressing economic considerations for educational institutions. The subsequent project aims to elevate accessibility and versatility by implementing Optical Mark Recognition (OMR) technology using an ordinary web camera. This approach introduces a more accessible and platform-independent data capture method. Utilizing PyCharm IDE for graphical layout ensures a consistent user interface across various operating systems. The system boasts an impressive accuracy level of 98%, showcasing its effectiveness in recognizing and processing marked information on OMR sheets. The user-friendly interface enhances ease of interaction for users with varying technical backgrounds, prioritizing not only accuracy but also efficiency through the incorporation of modern technologies.

Finally, the Image Processing-Based Robust Model for OMR Sheet Evaluation provides a forward-thinking solution to overcome the limitations of conventional OMR techniques. The model's primary objective is to ensure robustness, accuracy, and cost-effectiveness in OMR sheet evaluation. Its implementation involves a specialized image processing model designed for OMR sheet evaluation, boasting high accuracy while maintaining low time and computation complexity. The model's noteworthy features include robustness against variations in angles, blur, and light imbalances, making it suitable for real-time applications. One of its key advantages lies in portability and low-cost implementation, allowing for the use of mobile phones in capturing OMR sheet images. By eliminating the need for dedicated hardware, addressing challenges related to untrained staff, and overcoming issues associated with incorrect sheet orientations during scanning, this image processing model emerges as a versatile and efficient alternative, promising to enhance the reliability and accessibility of OMR sheet evaluation across various settings.

The OMR-Based Grading System for Academic Institutions marks a significant departure from traditional grading methodologies, introducing a transformative approach through the implementation of Optical Mark Recognition (OMR) technology. Leveraging widely available scanners, this system provides an automated and cost-effective solution for academic institutions, particularly catering to the imperative for affordable automation in contexts such as school contests. By integrating sophisticated image processing techniques on mobile devices, the system streamlines the grading of student response sheets, boasting an impressive recognition success rate of 97.6%. Key features, including the ability to generate default lists with a simple button push, underscore its efficiency and adaptability, making it especially suitable for large-scale assessments like surveys and questionnaires. Despite its prowess, the OMR-Based Grading System acknowledges certain limitations, notably with inaccurately printed or thin materials. However, the system maintains an overall error rate below 1.5%, positioning it as a reliable and cost-effective solution. Its flexibility to accommodate the specific needs of academic institutions makes it an invaluable tool in scenarios where budget constraints and efficiency considerations are paramount.
In contrast, the Camera-Based Grading System for Multiple-Choice Tests introduces an innovative paradigm for grading, leveraging cameras to enhance efficiency and reliability. Employing advanced techniques such as the Hough transform for image allocation, skew correction, and normalization, this system surpasses traditional OMR methods with remarkable improvements in accuracy, reliability, and reduced processing time. Noteworthy is its cost-efficiency, achieving high accuracy even with lower-cost non-trans-optic answer sheets, making it a financially viable solution for educational institutions keen on optimizing assessment procedures.

### 3.2 Advantages

The project, with its primary objective of delivering a cost-effective Optical Mark Recognition (OMR) solution, addresses a crucial need within educational institutions facing budget constraints. By leveraging common scanning technologies, the system ensures accessibility to a wide range of educational settings, making OMR capabilities available to institutions regardless of their financial limitations. This commitment to cost-effectiveness aligns with the broader goal of democratizing OMR technology and expanding its reach to educational institutions that may not have the resources for high-end scanning equipment.

The core strength of the project lies in its emphasis on automation and efficiency in the grading process. By automating the grading workflow, the system significantly reduces the time and effort required by educators. Capable of processing hundreds or even thousands of physical documents per hour, the OMR solution introduces a transformative efficiency boost to the grading process, allowing educators to focus on more strategic aspects of their roles, such as instructional improvement and student engagement.

The integration of a mobile application for image processing further enhances the system’s flexibility and convenience. Educators can utilize their mobile devices to capture and process student responses, eliminating the need for specialized equipment and enabling on-the-go assessment. This mobile integration not only contributes to the overall efficiency of the system but also aligns with the modern trend of leveraging mobile technology in educational practices.

Efficiency gains become especially evident when comparing the system's capabilities to traditional manual grading processes. Evaluating 1000 OMR sheets with a team of 100 people would typically be a time-consuming task. However, with the OMR grading system, the process becomes significantly more efficient, requiring less time and human resources. This not only streamlines the grading workflow but also minimizes the risk of human errors associated with manual assessment.

The high recognition success rate of 97.6% stands as a testament to the system's accuracy in identifying and processing marked answers on student response sheets. This level of precision instills confidence in educators and institutions regarding the reliability of the grading outcomes, contributing to the overall effectiveness of the OMR solution.

Furthermore, the system's adaptability to common scanning technologies is a strategic design choice, ensuring compatibility and accessibility across a wide spectrum of educational institutions. The avoidance of expensive or specialized hardware requirements makes the system more approachable, enabling institutions with diverse budgets to benefit from OMR capabilities without significant financial investments.

In conclusion, the project not only aims to provide a cost-effective OMR solution but also emphasizes automation, efficiency, mobile integration, and adaptability to common scanning technologies. By addressing these key aspects, the system aims to offer a practical, accessible, and transformative solution for educational institutions seeking to streamline their grading processes and enhance overall efficiency.

The cost-effective OMR solution envisioned by the project is a pivotal step in bridging accessibility gaps in educational technology. Leveraging common scanning technologies, the system becomes an inclusive tool for educational institutions with diverse budgetary considerations, ensuring that the benefits of OMR are not confined to well-funded establishments. This commitment to affordability aligns with the broader mission of promoting educational equity and equal access to advanced assessment methodologies.

The automation and efficiency embedded in the system present a paradigm shift in the grading landscape. By automating the grading process, educators witness a substantial reduction in time and effort, allowing for a more streamlined and effective workflow. With the capability to process hundreds or thousands of physical documents per hour, the OMR solution introduces unprecedented efficiency gains, liberating educators from the burdensome aspects of manual grading and empowering them to focus on qualitative aspects of teaching and learning.

The integration of a mobile application for image processing amplifies the system's impact by introducing flexibility and convenience. Educators can seamlessly use their mobile devices for capturing and processing student response sheets, eliminating dependencies on specialized equipment. This mobile-centric approach not only aligns with contemporary educational practices but also facilitates on-the-go assessment, catering to the dynamic and mobile nature of modern teaching environments.

Comparatively, the efficiency boosts achieved by the OMR solution become even more evident when contrasted with traditional manual grading approaches. Evaluating 1000 OMR sheets with a team of 100 individuals is a resource-intensive task; however, the automated system significantly reduces the time and human resources required, ushering in a new era of efficiency and accuracy in the grading process.

The impressive recognition success rate of 97.6% underscores the system's accuracy in deciphering and processing marked answers on student response sheets. This high level of precision not only instills confidence in the grading outcomes but
also contributes to the overall reliability of the assessment process. Educators can rely on the system to deliver consistent and accurate results, promoting a trust-based relationship between technology and assessment practices.

Moreover, the system's adaptability to common scanning technologies marks it as a versatile and accessible solution for a wide array of educational institutions. By sidestepping the need for expensive or specialized hardware, the OMR solution becomes an approachable and scalable tool for institutions of varying sizes and financial capacities. This adaptability ensures that the benefits of OMR are democratized, reaching educational settings with diverse infrastructural capabilities.

In conclusion, the project's multi-faceted approach not only strives to provide a cost-effective OMR solution but also champions automation, efficiency, mobile integration, and adaptability to common scanning technologies. Through these endeavors, the system emerges as a practical, accessible, and transformative solution, poised to enhance grading processes in educational institutions while promoting the principles of equity and inclusivity in education.

The envisioned cost-effective OMR solution represents a significant leap forward in fostering inclusive educational technology. By harnessing common scanning technologies, the system becomes a beacon of accessibility, ensuring that the advantages of Optical Mark Recognition (OMR) are extended to educational institutions across a spectrum of budgetary constraints. This commitment to affordability aligns with a broader mission to promote educational equity and provide equal access to advanced assessment methodologies, leveling the playing field for diverse institutions.

At the heart of the project lies the transformative power of automation and efficiency. The automated grading process not only revolutionizes the traditional approach but also liberates educators from the labor-intensive task of manual grading. Capable of processing hundreds or thousands of physical documents per hour, the OMR solution introduces unprecedented efficiency gains, empowering educators to allocate their time and efforts toward strategic aspects of teaching and learning.

The integration of a mobile application for image processing further elevates the system's impact, introducing flexibility and convenience into the grading process. Educators can seamlessly use their mobile devices for capturing and processing student response sheets, transcending the limitations of specialized equipment and embracing a mobile-centric approach aligned with contemporary educational practices. This adaptability facilitates on-the-go assessment, catering to the dynamic and mobile nature of modern teaching environments.

**Conclusion:**

The proposed OMR automated grading system emerges as a transformative solution for the efficient evaluation of answer sheets in exams conducted globally. By integrating OpenCV and diverse methodologies, it addresses challenges inherent in traditional manual grading methods and conventional OMR techniques, prioritizing efficiency, accuracy, and accessibility. The incorporation of OpenCV significantly enhances image processing capabilities, ensuring precise recognition of marked responses and setting new standards for modern OMR sheet-based assessments.

One of the system's notable advantages lies in its cost-effectiveness, providing an economical alternative for users unwilling to invest substantial capital in heavy machinery. Time, being a critical factor in human life, becomes a focal point for the system, saving valuable time by streamlining the evaluation process. The proven time for the system to evaluate a paper is a maximum of 60 seconds, showcasing its efficiency in delivering quick and accurate results. The algorithm employed checks for errors and computes the marks obtained by the candidate through straightforward procedures such as obtaining the image, converting it to grayscale, determining the intensity of each bubble, and tallying the counts.

The system's wide scope extends beyond exam evaluations, encompassing applications in surveys, attendance tracking, and various other domains. Leveraging OpenCV, a library dedicated to image processing, adds a layer of sophistication to the system. While C++ is commonly used for OpenCV, the implementation in Java for the Android platform enhances accessibility and ease of use, bringing relief to small institutions and regularizing options-based exams.

The Android-based implementation of the system eliminates concerns related to power consumption or energy wastage, making it an environmentally friendly solution. This innovative project aims to revolutionize OMR sheet processing by rendering expensive scanners obsolete, especially benefiting smaller institutions with limited resources. The hope is that this application will usher in a significant change, democratizing OMR sheet processing and making it more accessible and affordable.

In conclusion, the proposed OMR automated grading system not only offers an efficient and cost-effective solution for exam evaluations but also holds potential for broader applications. With its emphasis on time-saving, accuracy, and accessibility, coupled with the versatility of OpenCV and the Android platform, it represents a significant leap forward in the realm of assessment technologies, promising transformative changes in the way evaluations are conducted globally.

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