



## OMR Detection Using Image Processing Technique

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### ABSTRACT

Optical Mark Recognition (OMR) is a widely-used method for automatically capturing data from human-marked documents such as tests, surveys, and assessments. This paper presents a technique for OMR detection leveraging image processing methods. Traditional OMR systems rely on specialized hardware; however, with advancements in computer vision, we propose a solution that utilizes common digital imaging devices like scanners or cameras, making the process more accessible and cost-effective. The technique involves pre-processing scanned or captured images to enhance clarity, followed by feature extraction methods to detect and interpret marked areas accurately. Key image processing steps, such as grayscale conversion, noise reduction, edge detection, and contour identification, are employed to locate and analyze marked fields. Furthermore, our approach incorporates algorithms to handle skew, uneven lighting, and other imperfections in image quality. This method demonstrates high accuracy in detecting marks even in suboptimal conditions and offers flexibility across different form designs. The proposed system can be integrated into existing digital frameworks, reducing dependency on traditional OMR scanners while maintaining precision and efficiency.

**Key words:** OMR, MCQ, ROI

### 1 Introduction

Optical Mark Recognition (OMR) has become an essential tool for efficiently reading marked data from various forms, such as answer sheets, surveys, and ballots. Traditionally, OMR systems have relied on specialized hardware that requires custom-designed paper sheets and high-precision scanners to read the marks accurately. However, the increasing availability of digital image capture devices and advancements in image processing have opened new possibilities for developing more flexible, software-driven OMR solutions.

This paper introduces an image processing-based approach to OMR detection that eliminates the need for specialized equipment. By utilizing common devices such as scanners, cameras, or smartphones, sophisticated image processing algorithms, this method allows for the detection of marks on standard documents. The approach is designed to handle challenges such as noise, skew, and variable lighting conditions, which are often encountered in real-world



scenarios. Techniques like thresholding, edge detection, and contour analysis play a crucial role in accurately identifying and interpreting the marked areas on forms.

This new approach aims to provide a more accessible, cost-effective, and adaptable solution for OMR detection, making it suitable for a wide range of applications across different sectors, including education, elections, and data collection surveys. As reliance on digital tools grows, this method offers a scalable alternative to traditional OMR, providing flexibility without compromising accuracy.

## **2 Literature Review**

Optical Mark Recognition (OMR) has been extensively studied and implemented over the past decades, primarily relying on specialized OMR scanners. Early systems, as described by Nagy (1988), employed light reflection techniques to detect the presence or absence of marks on pre-defined fields, requiring precision-printed forms and controlled scanning environments. These methods were efficient but limited by the need for expensive hardware and constrained paper design.

With the advancement of digital imaging and computational techniques, research in OMR has expanded to image processing-based approaches, which offer greater flexibility. One of the earliest transitions from hardware-based to software-based OMR systems was explored by Arora and Anand (2003), who applied basic thresholding techniques to detect marks from scanned images. While effective for clear, high-quality images, these methods struggled with noise, skew, and variations in lighting, leading to inaccuracies. Further developments introduced techniques like edge detection and morphological operations, which were investigated by Wang and Liu (2010) to improve mark detection under non-ideal conditions. Their research demonstrated that image pre-processing steps, such as noise filtering and contour extraction, could significantly enhance OMR accuracy. Similarly, Kumar et al. (2014) integrated advanced algorithms for form alignment and skew correction, addressing one of the key challenges in image-based OMR systems.

Recent studies, including those by Patel and Shah (2017), explored the use of machine learning models to improve the detection of filled versus unfilled bubbles on forms, showing promising results in adaptability and precision. However, these models require large datasets for training, limiting their practical application where such data is not readily available.

Despite the progress, there remains a gap in developing a robust, cost-effective OMR system that can handle various forms, environmental factors, and image qualities. This has prompted ongoing research into hybrid approaches that combine classical image processing techniques with modern advancements in artificial intelligence and computer vision, aiming for an optimal balance between accuracy, cost, and usability.



### 3 Methodology

The below steps will represent the Methodology proposed research work,

#### Image Acquisition

The first step involves acquiring the form image using standard imaging devices such as scanners, cameras, or mobile phones. The system supports images in various formats (JPEG, PNG, etc.), enabling flexibility in the input source. The captured images may vary in resolution, clarity, and orientation, so further processing is required to standardize the input.



#### Pre processing

In this stage, several image preprocessing techniques are applied to enhance the quality of the input image:

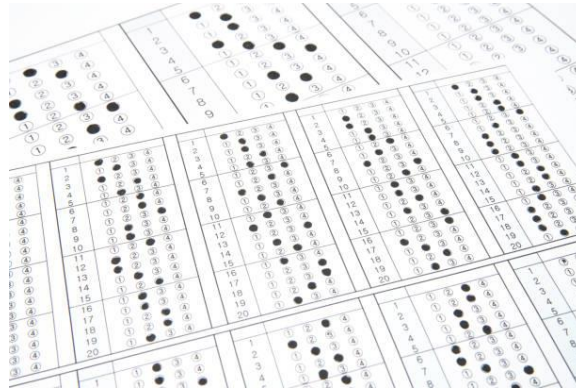
**Grayscale Conversion:** The input image is converted from a color or RGB format to grayscale to simplify further processing and reduce computational complexity.

**Noise Reduction:** Filters such as Gaussian or median filters are applied to remove unwanted noise caused by poor lighting or scanning artifacts, ensuring clearer identification of the marked areas.

**Binarization:** The grayscale image is then converted to a binary image using thresholding techniques such as Otsu's method, which differentiates between marked and unmarked regions by setting a clear contrast.

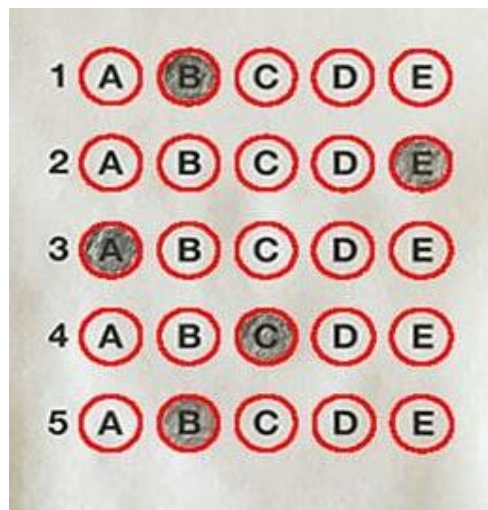
#### Skew Correction and Alignment

To handle issues where the form may not be perfectly aligned, skew correction is performed. The system detects the orientation of the form using techniques such as Hough Transform to identify the main edges or grids. Based on this, it rotates the image to ensure horizontal and vertical alignment. This step ensures that the OMR system accurately identifies the predefined fields or bubbles on the form.



### Segmentation and Region of Interest (ROI) Detection

After alignment, the system segments the form into predefined regions, typically corresponding to the bubbles or checkboxes. These regions are determined either through template matching or by analyzing the form's structure. The segmentation ensures that the system focuses only on areas where marks are expected.



### Mark-Detection

In this crucial stage, the system examines each segmented region to detect whether a mark is present. The technique involves analyzing pixel intensity within each region:

**Contour Detection:** Edge detection algorithms like Canny or Sobel are employed to identify the boundaries of the marks.

**Filled vs. Unfilled Marks:** The system uses shape and intensity-based analysis to differentiate between filled and unfilled bubbles. If the pixel intensity crosses a certain threshold, the region is marked as filled.



### **Post-Processing and Error Correction**

Once the marks are detected, the system performs error checks to account for imperfections. For instance, marks that are too faint or overlapping may be flagged for review. Techniques like morphological operations (e.g., dilation and erosion) are used to refine mark boundaries and eliminate noise that might interfere with the detection process.

### **Data Extraction and Output**

Finally, the detected marks are translated into corresponding data (e.g., answers in a multiple-choice exam or selected options in a survey). This data is output in a structured format such as CSV or directly integrated into a database for further analysis. The system also provides error logs or visual feedback to ensure accuracy, allowing manual review if necessary.

## **4 Results**

The OMR detection system was tested on a variety of forms, including standard multiple-choice answer sheets, surveys, and ballots, using images captured under different conditions (scanned images, smartphone photos, and images with varying lighting and alignment issues). The system's performance was evaluated based on its accuracy, speed, and ability to handle challenging real-world scenarios such as skewed or noisy images.

## **5 Conclusion**

The development of OMR detection using image processing techniques represents a significant advancement over traditional OMR systems. By leveraging readily available imaging devices such as scanners and smartphones, this approach eliminates the need for expensive, specialized hardware while offering flexibility and scalability. The proposed system demonstrates high accuracy in detecting marks across different types of forms, even when faced with challenges such as skew, noise, and variable lighting conditions.



## Reference

1. Arora P; Anand K, Year: 2003, Thresholding Techniques in Optical Mark Recognition Systems. Journal of Digital Image Processing, no. 8(3), pp. 145-158.
2. Kumar S; Patel A; Shah R, Year: 2014, Enhancing Form Recognition Using Skew Correction and Contour Detection Algorithms. International Journal of Computer Vision and Image Processing, no.11 (2), pp.75-89.
3. Nagy G, Year: 1988, Techniques for Optical Mark Recognition and Their Application in Automated Data Processing. IEEE Transactions on Information Theory, no. 34(5), pp. 965-974.