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# Image processing

*Team#12*



# ***Grades auto-filler***

## Team Members

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## Project Idea

The Grades Auto-Filler project is an automated grading system designed to streamline the evaluation process for multiple-choice and written assessments. It combines two specialized modules to address different aspects of grading: one for extracting scores from grades sheets that use symbols and numbers, and another for scoring bubble sheets based on filled-in answers. By automating the extraction, interpretation, and digital recording of grades from these diverse input formats, the project significantly reduces manual work, ensuring accurate and efficient grading.

# Need for the Grades Auto-Filler Project

Grading large numbers of student assessments manually is a slow and error-prone process, especially when exams include different types of questions and formats. The Grades Auto-Filler project addresses the following key needs:

## Time Savings

Grading exams with both bubble sheets and grades sheets takes a lot of time. Automating this process reduces grading time significantly, allowing educators to focus more on teaching.

## Improved Accuracy

Human errors in grading and data entry are common in manual grading, which can affect students' scores unfairly. Automation ensures that grades are calculated accurately and consistently across all students.

## Versatility for Different Formats

This system can process both grades' sheets with symbols or numbers and multiple-choice bubble sheets, making it adaptable to various types of assessments without needing different grading tools.

# ***Grades sheet***

## Block Diagram

### **1. Input Image**

- **Input:** An image file of the grades sheet captured by a mobile camera.
- **Output:** Raw image data ready for preprocessing.
- **Method:** Image acquisition from the user.

### **2. Preprocessing**

- **Input:** Raw image data of the bubble sheet.
- **Output:** A corrected image that is straightened and scaled appropriately for further processing.
- **Methods:**

#### **Image Correction Techniques:**

- **Skew Correction:** Algorithm to detect and correct the angle of the sheet.
- **Orientation Adjustment:** Determine the correct orientation.
- **Scaling:** Resizing the image to a standard size using interpolation methods.

### 3. Optical Character Recognition (OCR)

- **Input:** Preprocessed image data.
- **Output:** Extracted student IDs (text) and numeric values (if applicable).
- **Methods:**
  - OCR Method Selection:**
    - **Method 1:** Utilize a pre-built OCR library like Tesseract to extract text directly from the image.
    - **Method 2:** Implement a custom classifier to identify and extract text.

### 4. Symbol Recognition

- **Input:** Preprocessed image data.
- **Output:** A list of interpreted symbols and their corresponding values based on predefined rules (e.g.,  $\checkmark = 5$ ,  $\boxtimes = 0$ , etc.).
- **Methods:**
  - Symbol Detection Techniques:**
    - Image segmentation to isolate cells and symbols.
    - Pattern recognition algorithms to interpret specific symbols in each cell.

## 5. Grading Logic

- **Input:** List of interpreted symbols from the symbol recognition step.
- **Output:** A structured list or dictionary containing grades for each student based on the interpreted symbols.
- **Methods:**
  - Grading Algorithm:**
    - Implement a function that maps each recognized symbol to its corresponding score based on the specified rules.
    - Aggregate scores for each student into a result format (e.g., a list or dictionary).

## 6. Excel Generation

- **Input:** List of student IDs and corresponding grades from the grading logic step.
- **Output:** An Excel file containing a formatted graded sheet with student IDs and scores.
- **Methods:**
  - Excel Export Function:**
    - Use libraries like pandas and openpyxl to create and format an Excel workbook.
    - Populate the Excel file with the extracted student IDs and their grades, including any necessary formatting (e.g., headers, borders).

## Non primitive functions

Function	Description	Implementation
Skew Correction	Detect and correct the skew angle of the image	From Scratch
Orientation Adjustment	Adjust the image to the correct orientation	From Scratch
Scaling	Resize the image to a standard size	Can use OpenCV or implement from scratch
Printed Student ID Extraction and numeric (OCR)	Recognize IDs using Tesseract or custom classifier	Method 1: No implementation Method 2: Custom features + classifier
Symbol Detection and Interpretation	Detect and interpret handwritten symbols	From Scratch
Export to Excel	Generate Excel file with results  Use libraries or implement	from scratch

# ***Bubble sheet correction***

## Block Diagram of the Project

### **Image Acquisition:**

- **Input:** Captured image of the completed bubble sheet.
- **Output:** Digital image file ready for processing.
- **Method:** Use a camera to obtain high-resolution images of bubble sheets.

### **Image Preprocessing:**

- **Input:** Bubble sheet image.
- **Output:** Enhanced image with clear delineation of bubbles.
- **Method:** Image enhancement techniques such as gray scale, noise reduction, edge detection and Skew Correction.

### **Find & Filter Contours:**

- **Input:** Preprocessed image section containing the student ID.
- **Output:** Identified bubbles and ID box.
- **Method:** Contour detection to identify and outline the shapes of the bubbles and student ID box.



## **Student ID Recognition:**

- **Input:** Cropped image section containing the student ID.
- **Output:** Extracted student ID text.
- **Method:** Optical Character Recognition (OCR) for the ID section.

## **Determine Filled Bubbles**

- **Input:** Detected bubble contours.
- **Output:** List of Selected Answers (indicating which bubbles are filled and their corresponding answers).
- **Method:** Thresholds.

## **Grading and Scoring:**

- **Input:** List of Selected Answers.
- **Output:** Final score or grade for the student.
- **Method:** Scoring algorithm to calculate results based on correct answers.

## Non primitive functions

Function	Description	Implementation
<b>Skew Correction</b>	Corrects any angle or tilt in the image.	From Scratch
Contour Filtering	Filters out irrelevant contours to isolate bubbles and ID box.	From Scratch
ID Box Identification	Identifies and isolates the ID box.	From Scratch
Filled Bubble Detection	Determines which bubbles are filled based on pixel density or intensity.	From Scratch
Score Calculation	Compares answers and calculates the grade.	from scratch

## Scientific paper(s)

- OCR

<https://ieeexplore.ieee.org/document/9151144>

- Edge detection

[A comprehensive study of edge detection for image processing applications | IEEE Conference Publication | IEEE Xplore](#)