Smart Answer Sheet Alignment and Evaluation System (SASES)

Background

Educational institutions worldwide process millions of answer sheets annually using digital evaluation systems. Despite technological advancements, two persistent challenges remain:

- **Scanned Answer Sheet Alignment** – Student answer sheets often suffer from distortions (skew, scaling, perspective shifts, noise), leading to poor alignment with the original question template.

- **Automated Evaluation of Structured Questions** – Current systems struggle to auto-grade handwritten answers for MCQs, fill-in-the-blanks, or one-word responses, resulting in manual intervention and reduced scalability.

Problem Statement

Develop a **multi-agentic AI system** that integrates image processing, computer vision, and AI/LLM components to:

- Automatically correctly align scanned handwritten student answer sheets to match the original question paper template.

- Extract and evaluate answers for structured question types (MCQ, fill-in-the-blank, one-word response) by comparing them with a reference answer script.

- Produce interpretable outputs including: aligned student sheet, transformation parameters, alignment accuracy, and auto-evaluation results.

Problem Description

When students' handwritten answer sheets are scanned for digital evaluation, multiple issues compromise both the alignment and the evaluation process.

Common Distortions (Alignment Issues) Include:

- **Skewness:** Papers placed at angles during scanning ($\pm15°$ rotation).

- **Perspective Distortion:** Non-flat placement causing trapezoidal effects.

- **Scale Variations:** Different scanner settings or paper sizes ($\pm10\%$ variation).

- **Translation Shifts:** Papers not aligned with scanner edges (x,y displacement).

- **Padding/Margins:** Inconsistent white space around content.

- **Paper Deformations:** Wrinkles, folds, or curves in the paper.

- **Noise & Artifacts:** Scanner dust, shadows, compression artifacts.

- **Contrast/Brightness Variations:** Due to scanning or lighting differences.

Common Distortions (Issues in Auto-Evaluation) Include:

- **Handwriting Variability:** Differences in writing style, spacing, and slant.

- **Spelling Variations:** Minor spelling mistakes or synonyms in fill-in-the-blank answers.

- **Answer Positioning Errors:** Writing outside designated boxes or overlapping with questions.

- **Overwriting/Strikethroughs:** Multiple attempts in the same space causing ambiguity.

- **Multiple Markings in MCQs:** Ambiguous ticks, erasures, or use of unclear symbols.

- **Faint/Blurred Writing:** Pencil answers or faint ink reducing recognition accuracy.

- **Noise Interference:** Smudges, ink bleeding, or scanning shadows.

- **Reference Script Rigidity:** Strict matching may not account for valid alternate answers.

Technical Requirements

Input:

- Original question paper template.

- Scanned student answer sheet.

- Reference answer script.

  Expected Output:

- Correctly aligned answer sheet image.

- Transformation parameters applied.

- Alignment accuracy/confidence score.

- Auto-evaluated results with per-question marks.

Constraints

- Preserve all student handwriting without loss.

- Support standard document formats (JPEG, PNG).

- Maintain resolution $\geq$ 300 DPI.

- No specialized hardware required.

Bonus Challenges

- Multi-page support for stapled booklets.

- Damage recovery for torn or faded sheets.

- Real-time preview of alignment corrections.

- Handwriting readability enhancement.

- Automated validation: flagging uncertain cases for manual review.

- Explainable evaluation: showing why a response was marked correct/incorrect.

Deliverables

- Working prototype/application.

- Source code with documentation.

- Test results on provided dataset.

- Technical approach document (with agent responsibilities).

- Draft of the research paper (If innovations are involved in the process)

- Demo video (3–5 minutes).