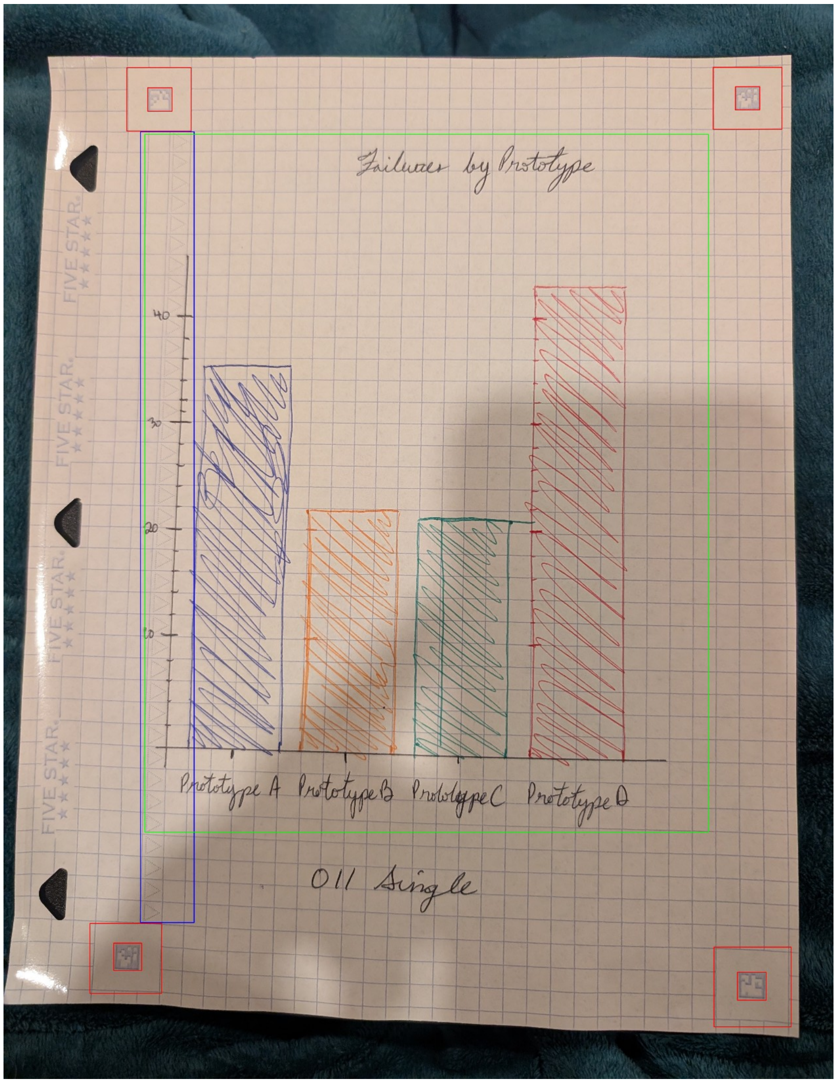
FieldChartOCR: Extraction of Handwritten Charts and Tables



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0. Abstract

Handwritten charts and technical notes are rich with quantitative insight yet remain locked inside scanned pages. FieldChartOCR extends ChartOCR to converting hand-drawn charts and tables into structured datasets. The procedure goes through chart classification, element detection, and handwriting OCR, to information extraction. The focus is on delivering a practical tool that field technicians and researchers can rely on without exhaustive manual transcription.

1. Introduction

Digitizing handwritten technical notebooks is labour-intensive. Engineers, students, and analysts rely on annotations, sketches, and mixed layouts that resist automated extraction. Existing OCR tools, like ChartOCR, provide plain text at best; they ignore hand-drawn informatics in order to optimize accuracy. On the other hand, professionals (such as field technicians) must manually re-create charts in tools such as Excel, Desmos, or CAD systems—a significant barrier to iteration and collaboration.

The goal of FieldChartOCR is to build a unified pipeline that ingests handwritten graphs, tables, and mechanical annotations and produces structured artifacts suitable for analytics and visualization. By coupling deep learning with rule-based reasoning, I hope to generalize across chart families while maintaining transparency in intermediate outputs. Delivering this capability advances document understanding, accelerates knowledge sharing, and supports accessibility by providing machine-readable alternatives to complex figures.

2. Related Work

- **Chart Understanding Frameworks:** ChartOCR's hybrid keypoint-and-rule architecture demonstrates the effectiveness of combining deep detection with domain logic. ChartSense and ReVision apply rule-based heuristics but struggle with diverse layouts. DVQA and FigureQA focus on question answering but assume neatly rendered charts.
- **Diagram & Table Recognition:** DiagramParseNet and other graph-parsing models detect nodes and edges in structured diagrams. DeepDeSRT and PubTabNet handle printed tables yet rely on sharp lines and consistent fonts, unlike the irregular strokes in hand-drawn notes.
- **Handwriting OCR & Math Recognition:** Transformer-based handwriting recognizers and MathOCR systems convert cursive and symbolic notation into LaTeX. They typically operate on grayscale inputs and overlook complex layouts.
- **Document Normalization & Imaging:** Research on illumination correction and phase-based representations inspires our preprocessing layer. Multispectral imaging studies inform our roadmap for future sensing modalities.

3. Proposed Work

3.1 Data Sources

- handwritten bar chart diagrams
- synthesized datasets in comma separated lists
- bar charts generated with `matplotlib`

3.2 System Architecture

1. **Preprocessing & Layout Normalization**
    - Perform denoising, skew correction, grid suppression, and edge enhancement tailored to notebook paper.
    - Standardize contrast and dynamic range to support downstream detectors.
    - **Note:** I may move to scanning the images if this part proves too onerous.
2. **Chart Type Classification**
    - Lightweight CNN-transformer hybrid predicts dominant chart categories for each region.
        - The goal is to match the 3 charts recognized by ChartOCR: bar charts, line charts, and pie charts.
    - Supports mixed-content pages by assigning probabilities per region.
3. **Element Identification & OCR**
    - Shared detection backbone with heads for axes, scales, titles, data marks, and table structure.
4. **Semantic Assembly & Output**
    - Associates text blocks with detected elements, enforces basic geometric constraints, and exports Markdown summaries plus CSV datasets.

3.3 Development Plan

- **Phase 1:** Build preprocessing pipeline, layout normalization, and table-to-CSV baseline.
- **Phase 2:** Train chart classifier and core element detectors; integrate handwriting OCR.
- **Phase 3:** Finalize semantic assembly, polish outputs, and iterate on error analysis.

4. Evaluation Plan

- **Effectiveness Metrics**
  - Chart classification macro-F1 across core categories (bar, line, scatter, tables).
  - Element detection precision/recall for axes, titles, and data marks.
  - OCR character error rate (CER) and table reconstruction F1.
- **Efficiency Metrics**
  - End-to-end runtime per page and memory footprint.
- **Experimental Setup**
  - Stratified train/validation/test split by chart type and handwriting style.
  - Baselines: ChartOCR, generic OCR plus heuristic extraction, and manual transcription samples.
  - Ablations on preprocessing and semantic assembly.

5. Timeline & Milestones

Phase	Milestone
1	Finalize annotation schema, label initial dataset.
2	**Implement normalization prototype, integrate baseline handwriting OCR and chart classifier; evaluate on sample pages. (CURRENT)**
3	Deploy element detectors and table recognizer; stand up Markdown/CSV writers.
4	Iterate on semantic assembly, run core evaluations, and prepare presentation materials.

Current progress: synthesized dataset, building dataset for QC square recognition using GIMP commandline.

6. Risks and Mitigation

- **Limited Hand-Drawn Training Data**
    - Mitigation: remove the information extraction steps and keep only the classification.
- **Complex Page Layouts**
    - Mitigation: flag difficult cases for human review.
- **Lighting Noise**
    - Mitigation: use normalization targets, augment brightness/contrast, and monitor detector confidence.

7. Conclusion and Future Work

Currently, FieldChartOCR is stuck in the early stages of OCR work. The page corner detection requires more fine-tuning to become robust. On an ideal sample photo, 4 corners are detected and the image can be cropped. However, average case scenarios where 1 or more corners are not detected proves difficult to remedy. I am improving the corner detection function by augmenting samples of the QC squares with computer-edited samples.

References

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Appendices

A1: Bar Chart Examples

A2: Page Normalization

A3: Custom Page Types and Features

A4: Example of Custom Anti-Cheat Paper