Main

March 27, 2025

1 Text Detection and Extraction

1.0.1 This jupyter-notebook processes images to detect text blocks using a YOLO model, extracts text with Tesseract OCR and visualizes the results.

1.1 Overview of the Code

This Python script processes images to detect and extract text, then evaluates the accuracy of the extracted text against ground truth data. Here's what it does at a high level:

1. Text Detection: Uses a YOLO model to identify text blocks in images.

2. Text Extraction: Employs Tesseract OCR to extract text from these blocks.

3. Evaluation: Compares the extracted text to ground truth text using word-level accuracy and Levenshtein similarity.

4. Visualization: Displays an example image with detected text blocks highlighted.

The script is designed to work with historical Spanish documents, which influences some of its design choices.

1.2 Step-by-Step Explanation

1.2.1 1. Importing Libraries

[3]:

```python
import os
import cv2
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from ultralytics import YOLO
from paddleocr import PaddleOCR
from pathlib import Path
import pytesseract
import re
```

```
from collections import defaultdict
from Levenshtein import distance as levenshtein_distance
```

1.2.2 2. Setting Up Paths and Variables

Here I have used custom dataset made using label-studios consisting images provided by HumanAI. This image only contains 32 images as annotating is a long tedious task.

[57]:
```
IMAGE_DIR = "Layout-3TextExtract"  # Directory containing images
TXT_DIR = "transcriptions1"  # Directory containing ground truth .txt files
MODEL_PATH = "best.pt"  # This is custom model check out my github to get the␣
 ↪weights (There is the detailed explanation of how this model was trained)
OUTPUT_DIR = "output"  # Output directory
EXTRACTED_LAYOUTS_DIR = os.path.join(OUTPUT_DIR, "extracted_layouts")  # For␣
 ↪cropped text blocks
EXTRACTED_TEXTS_DIR = os.path.join(OUTPUT_DIR, "extracted_texts")  # For extract
EVALUATION_CSV_PATH = os.path.join(OUTPUT_DIR, "evaluation_results.csv")
NEW_CSV_PATH = os.path.join(OUTPUT_DIR, "combined_results.csv")
```

[45]:
```
os.makedirs(EXTRACTED_LAYOUTS_DIR, exist_ok=True)
os.makedirs(EXTRACTED_TEXTS_DIR, exist_ok=True)
```

1.2.3 3. Setting Up Custom Trained Yolo model Best fit for Historical Documents

This model was trained on the dataset given by HumanAI and also large datasets for document layout extraction present on roboflow. Checkout the detailed explanation of how this model was trained on my github. ### GitHub Repository

Check out the code on GitHub: Cool Project

[47]:
```
print("Loading YOLO model...")
yolo_model = YOLO(MODEL_PATH)
```

```
Loading YOLO model…
```

[49]:
```
image_files = [f for f in os.listdir(IMAGE_DIR) if f.lower().endswith(('.jpg',␣
 ↪'.jpeg', '.png'))]
print(f"Found {len(image_files)} images in {IMAGE_DIR}")
```

```
Found 32 images in Layout-3TextExtract
```

1.2.4 4. Loading the OCR.

I am using the Tesseract-OCR for extracting text.

Reasons being that tesseract is quite good at handling documents with distorted text such as these historical documents and also tesseract has a model that is pretrained on spanish data and is good at extracting spanish text.

Tesseract-OCR: Tesseract extracts text with the configuration `--oem 3 --psm 3 -l spa`: #### - `--oem 3`: Default OCR engine mode. #### - `--psm 3`: Assumes a single uniform text block (suitable for document snippets). #### - `-l spa`: Uses the Spanish language model (`spa.traineddata`). ### Why Use `spa.traineddata`? #### - **What**: The `-l spa` flag tells Tesseract to use the Spanish language model (`spa.traineddata`). #### - **Why**: This script targets Spanish text, likely historical documents. The Spanish model is trained to recognize: #### - Spanish-specific characters (e.g., 'ñ', 'á', 'é', 'í', 'ó', 'ú'). #### - Linguistic patterns of Spanish words. #### Using `spa.traineddata` improves OCR accuracy for Spanish compared to the default English model (`eng.traineddata`), especially for accented characters or historical variants.

[51]:
```python
pytesseract.pytesseract.tesseract_cmd = r'C:\Program Files\Tesseract-OCR\tesseract.exe'  # Windows
```

[52]:
```python
tesseract_config = r'--oem 3 --psm 6 -l spa'
```

[53]:
```python
image_files = [f for f in os.listdir(IMAGE_DIR) if f.lower().endswith(('.jpg', '.jpeg', '.png'))]
print(f"Found {len(image_files)} images in {IMAGE_DIR}")
```

```
Found 32 images in Layout-3TextExtract
```

1.2.5 Encoding issue.

The encoding issue arises when text data, especially from historical documents or OCR output, contains characters that are misinterpreted due to mismatched or incorrect character encodings. This is common when dealing with non-ASCII characters (e.g., accented letters in Spanish like ñ, á, é) or special characters (e.g., the long "s" ſ in historical texts).

Since 'ñ' is a non-ASCII it is predicted as 'Ã±' this is common issue when dealing with accents. This function fixes that issue.

Historical Spanish texts often use characters like the long "s" (ſ), which Tesseract might misinterpret as f or leave as-is, causing mismatches during evaluation

[54]:
```python
def clean_historical_text(text):
    # Join if it's a list
    if isinstance(text, list):
        text = " ".join(text)

    # Replace long "s" misinterpretations
    text = text.replace('ſ', 's')  # Tesseract may already handle this, but normalize for comparison
    text = re.sub(r'ſ(?=[aeiouáéíóúh])', 's', text, flags=re.IGNORECASE)
    text = re.sub(r'suerza', 'fuerza', text)  # Avoid incorrect replacements

    # Fix encoding issues (less common with Tesseract, but just in case)
    text = text.replace('Ã±', 'ñ')
    text = text.replace('Ã¡', 'á')
    text = text.replace('Ã©', 'é')
    text = text.replace('Ã', 'í')
    text = text.replace('Ã³', 'ó')
    text = text.replace('Ãº', 'ú')
    text = text.replace('Ã', 'í')

    # Remove extra punctuation and normalize spaces
    text = re.sub(r'[^\w\s]', '', text)  # Remove punctuation
    text = re.sub(r'\s+', ' ', text)  # Normalize spaces

    return text.strip().lower()

# Dictionary to store results for evaluation
results = defaultdict(dict)
```

1.2.6 5. Extracting text.

Extracting the text blocks from the image, then extracting the text from the text block. Further saving the extracted image and and the text block. Check out the github repository for the result. Cool Project

[58]:
```
for image_file in image_files:
    image_path = os.path.join(IMAGE_DIR, image_file)
    image_name = os.path.splitext(image_file)[0]
    print(f"\nProcessing {image_file}...")

    # Load the image
    image = cv2.imread(image_path)
    if image is None:
        print(f"Failed to load image: {image_path}")
        continue
    image_rgb = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)

    # Step 4.1: Use YOLO to detect text blocks
    print("Detecting text blocks with YOLO...")
    yolo_results = yolo_model(image_rgb, conf=0.3)

    # Extract bounding boxes
    text_blocks = []
    for result in yolo_results:
        boxes = result.boxes.xyxy.cpu().numpy()
        for idx, box in enumerate(boxes):
            x1, y1, x2, y2 = map(int, box)
            text_block = image[y1:y2, x1:x2]
            text_blocks.append((text_block, (x1, y1, x2, y2)))

    # Step 4.2: Save cropped text blocks and extract text with Tesseract
    extracted_texts = []
    for idx, (text_block, bbox) in enumerate(text_blocks):
        crop_filename = f"{image_name}_textblock_{idx}.jpg"
        crop_path = os.path.join(EXTRACTED_LAYOUTS_DIR, crop_filename)
        cv2.imwrite(crop_path, text_block)
        print(f"Saved cropped text block: {crop_path}")

        gray = cv2.cvtColor(text_block, cv2.COLOR_BGR2GRAY)
        _, thresh = cv2.threshold(gray, 0, 255, cv2.THRESH_BINARY + cv2.
↪THRESH_OTSU)

        print(f"Extracting text from text block {idx}...")
        extracted_text = pytesseract.image_to_string(thresh,␣
↪config=tesseract_config)
        extracted_texts.append(extracted_text.strip())

    # Step 4.3: Save the extracted text
    extracted_text_filename = f"{image_name}.txt"
    extracted_text_path = os.path.join(EXTRACTED_TEXTS_DIR,␣
↪extracted_text_filename)
    with open(extracted_text_path, 'w', encoding='utf-8') as f:
        f.write("\n".join(extracted_texts))
    print(f"Saved extracted text: {extracted_text_path}")

    # Clean and normalize the extracted text
    cleaned_extracted_text = clean_historical_text(extracted_texts)
    results[image_name]['extracted_text'] = cleaned_extracted_text.split()

    # Step 4.4: Load the ground truth text
    ground_truth_path = os.path.join(TXT_DIR, f"{image_name}.txt")
    if not os.path.exists(ground_truth_path):
        print(f"Ground truth file not found: {ground_truth_path}")
        results[image_name]['ground_truth'] = []
        continue

    with open(ground_truth_path, 'r', encoding='utf-8') as f:
        ground_truth_text = f.read().strip()
    cleaned_ground_truth = clean_historical_text(ground_truth_text)
    results[image_name]['ground_truth'] = cleaned_ground_truth.split()
    results[image_name]['raw_ground_truth'] = ground_truth_text
```

```
Processing Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65.jpg…
Detecting text blocks with YOLO…

0: 640x640 5 Images, 5 texts, 67.3ms
Speed: 2.1ms preprocess, 67.3ms inference, 0.5ms postprocess per image at shape
```

```
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_4.jpg
Extracting text from text block 4…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_5.jpg
Extracting text from text block 5…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_6.jpg
Extracting text from text block 6…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_7.jpg
Extracting text from text block 7…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_8.jpg
Extracting text from text block 8…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65_textblock_9.jpg
Extracting text from text block 9…
Saved extracted text: output\extracted_texts\Buendia-
Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65.txt

Processing Buendia-
Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74.jpg…
Detecting text blocks with YOLO…

0: 640x640 6 texts, 119.0ms
Speed: 3.7ms preprocess, 119.0ms inference, 1.0ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Buendia-
```

```
Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74_textblock_4.jpg
Extracting text from text block 4…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74_textblock_5.jpg
Extracting text from text block 5…
Saved extracted text: output\extracted_texts\Buendia-
Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74.txt

Processing Buendia-
Instruccion_pdf_page_3_png.rf.1507d0da8b268b462acb22ac7fc676b4.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 Image, 5 texts, 118.3ms
Speed: 3.6ms preprocess, 118.3ms inference, 1.1ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_3_png.rf.1507d0da8b268b462acb22ac7fc676b4_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_3_png.rf.1507d0da8b268b462acb22ac7fc676b4_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_3_png.rf.1507d0da8b268b462acb22ac7fc676b4_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_3_png.rf.1507d0da8b268b462acb22ac7fc676b4_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_3_png.rf.1507d0da8b268b462acb22ac7fc676b4_textblock_4.jpg
Extracting text from text block 4…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_3_png.rf.1507d0da8b268b462acb22ac7fc676b4_textblock_5.jpg
Extracting text from text block 5…
Saved extracted text: output\extracted_texts\Buendia-
Instruccion_pdf_page_3_png.rf.1507d0da8b268b462acb22ac7fc676b4.txt

Processing Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de.jpg…
Detecting text blocks with YOLO…

0: 640x640 8 texts, 110.9ms
Speed: 3.2ms preprocess, 110.9ms inference, 1.0ms postprocess per image at shape
```

```
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de_textblock_4.jpg
Extracting text from text block 4…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de_textblock_5.jpg
Extracting text from text block 5…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de_textblock_6.jpg
Extracting text from text block 6…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de_textblock_7.jpg
Extracting text from text block 7…
Saved extracted text: output\extracted_texts\Buendia-
Instruccion_pdf_page_4_png.rf.e61e9006b4ab8ce295831033c8f265de.txt

Processing Buendia-
Instruccion_pdf_page_5_png.rf.e356bea28e4331a8e366668521c25238.jpg…
Detecting text blocks with YOLO…

0: 640x640 4 texts, 109.6ms
Speed: 3.1ms preprocess, 109.6ms inference, 1.0ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_5_png.rf.e356bea28e4331a8e366668521c25238_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_5_png.rf.e356bea28e4331a8e366668521c25238_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_5_png.rf.e356bea28e4331a8e366668521c25238_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_5_png.rf.e356bea28e4331a8e366668521c25238_textblock_3.jpg
Extracting text from text block 3…
Saved extracted text: output\extracted_texts\Buendia-
```

```
Instruccion_pdf_page_5_png.rf.e356bea28e4331a8e366668521c25238.txt

Processing Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938.jpg…
Detecting text blocks with YOLO…

0: 640x640 9 texts, 100.9ms
Speed: 3.0ms preprocess, 100.9ms inference, 0.9ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938_textblock_4.jpg
Extracting text from text block 4…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938_textblock_5.jpg
Extracting text from text block 5…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938_textblock_6.jpg
Extracting text from text block 6…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938_textblock_7.jpg
Extracting text from text block 7…
Saved cropped text block: output\extracted_layouts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938_textblock_8.jpg
Extracting text from text block 8…
Saved extracted text: output\extracted_texts\Buendia-
Instruccion_pdf_page_6_png.rf.4d6abc7647183e67c3ba93ea8d71e938.txt

Processing Constituciones-sinodales-
Calahorra-1602_pdf_page_1_png.rf.224a39c994a0ebe3c052aee74a36d165.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 Image, 1 text, 123.4ms
Speed: 3.0ms preprocess, 123.4ms inference, 1.1ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_1_png.rf.224a39c994a0ebe3c052aee74a36d165_textblock_0.jpg
```

```
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_1_png.rf.224a39c994a0ebe3c052aee74a36d165_textblock_1.jpg
Extracting text from text block 1…
Saved extracted text: output\extracted_texts\Constituciones-sinodales-
Calahorra-1602_pdf_page_1_png.rf.224a39c994a0ebe3c052aee74a36d165.txt
Ground truth file not found: transcriptions1\Constituciones-sinodales-
Calahorra-1602_pdf_page_1_png.rf.224a39c994a0ebe3c052aee74a36d165.txt

Processing Constituciones-sinodales-
Calahorra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084.jpg…
Detecting text blocks with YOLO…

0: 640x640 7 texts, 108.8ms
Speed: 2.9ms preprocess, 108.8ms inference, 0.9ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084_textblock_4.jpg
Extracting text from text block 4…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084_textblock_5.jpg
Extracting text from text block 5…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084_textblock_6.jpg
Extracting text from text block 6…
Saved extracted text: output\extracted_texts\Constituciones-sinodales-
Calahorra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084.txt
Ground truth file not found: transcriptions1\Constituciones-sinodales-
Calahorra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084.txt

Processing Constituciones-sinodales-
Calahorra-1602_pdf_page_4_png.rf.e4a6820aadf62a1ce5c619220cb7d863.jpg…
Detecting text blocks with YOLO…

0: 640x640 2 texts, 368.1ms
Speed: 5.9ms preprocess, 368.1ms inference, 2.0ms postprocess per image at shape
```

```
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_4_png.rf.e4a6820aadf62a1ce5c619220cb7d863_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_4_png.rf.e4a6820aadf62a1ce5c619220cb7d863_textblock_1.jpg
Extracting text from text block 1…
Saved extracted text: output\extracted_texts\Constituciones-sinodales-
Calahorra-1602_pdf_page_4_png.rf.e4a6820aadf62a1ce5c619220cb7d863.txt
Ground truth file not found: transcriptions1\Constituciones-sinodales-
Calahorra-1602_pdf_page_4_png.rf.e4a6820aadf62a1ce5c619220cb7d863.txt

Processing Constituciones-sinodales-
Calahorra-1602_pdf_page_5_png.rf.a3e5c87bfbd3cf34c01ca0fa402799b0.jpg…
Detecting text blocks with YOLO…

0: 640x640 4 texts, 361.5ms
Speed: 9.1ms preprocess, 361.5ms inference, 1.4ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_5_png.rf.a3e5c87bfbd3cf34c01ca0fa402799b0_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_5_png.rf.a3e5c87bfbd3cf34c01ca0fa402799b0_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_5_png.rf.a3e5c87bfbd3cf34c01ca0fa402799b0_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_5_png.rf.a3e5c87bfbd3cf34c01ca0fa402799b0_textblock_3.jpg
Extracting text from text block 3…
Saved extracted text: output\extracted_texts\Constituciones-sinodales-
Calahorra-1602_pdf_page_5_png.rf.a3e5c87bfbd3cf34c01ca0fa402799b0.txt
Ground truth file not found: transcriptions1\Constituciones-sinodales-
Calahorra-1602_pdf_page_5_png.rf.a3e5c87bfbd3cf34c01ca0fa402799b0.txt

Processing Constituciones-sinodales-
Calahorra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 Image, 5 texts, 315.9ms
Speed: 5.4ms preprocess, 315.9ms inference, 1.8ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223_textblock_1.jpg
```

```
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223_textblock_4.jpg
Extracting text from text block 4…
Saved cropped text block: output\extracted_layouts\Constituciones-sinodales-Cala
horra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223_textblock_5.jpg
Extracting text from text block 5…
Saved extracted text: output\extracted_texts\Constituciones-sinodales-
Calahorra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223.txt
Ground truth file not found: transcriptions1\Constituciones-sinodales-
Calahorra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223.txt

Processing Ezcaray-
Vozes_pdf_page_10_png.rf.e098b341498eb1b0f3eabdf7c1392a83.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 text, 429.2ms
Speed: 8.1ms preprocess, 429.2ms inference, 2.9ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_10_png.rf.e098b341498eb1b0f3eabdf7c1392a83_textblock_0.jpg
Extracting text from text block 0…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_10_png.rf.e098b341498eb1b0f3eabdf7c1392a83.txt

Processing Ezcaray-
Vozes_pdf_page_11_png.rf.86e6c9ec0da33433ac03c9ffbe7ee12c.jpg…
Detecting text blocks with YOLO…

0: 640x640 7 texts, 385.5ms
Speed: 3.8ms preprocess, 385.5ms inference, 2.1ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_11_png.rf.86e6c9ec0da33433ac03c9ffbe7ee12c_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_11_png.rf.86e6c9ec0da33433ac03c9ffbe7ee12c_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_11_png.rf.86e6c9ec0da33433ac03c9ffbe7ee12c_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Ezcaray-
```

```
Vozes_pdf_page_11_png.rf.86e6c9ec0da33433ac03c9ffbe7ee12c_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_11_png.rf.86e6c9ec0da33433ac03c9ffbe7ee12c_textblock_4.jpg
Extracting text from text block 4…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_11_png.rf.86e6c9ec0da33433ac03c9ffbe7ee12c_textblock_5.jpg
Extracting text from text block 5…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_11_png.rf.86e6c9ec0da33433ac03c9ffbe7ee12c_textblock_6.jpg
Extracting text from text block 6…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_11_png.rf.86e6c9ec0da33433ac03c9ffbe7ee12c.txt

Processing Ezcaray-
Vozes_pdf_page_1_png.rf.868929ed16b784a193913d60a4cbc062.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 Image, 5 texts, 237.0ms
Speed: 5.3ms preprocess, 237.0ms inference, 1.9ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_1_png.rf.868929ed16b784a193913d60a4cbc062_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_1_png.rf.868929ed16b784a193913d60a4cbc062_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_1_png.rf.868929ed16b784a193913d60a4cbc062_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_1_png.rf.868929ed16b784a193913d60a4cbc062_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_1_png.rf.868929ed16b784a193913d60a4cbc062_textblock_4.jpg
Extracting text from text block 4…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_1_png.rf.868929ed16b784a193913d60a4cbc062_textblock_5.jpg
Extracting text from text block 5…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_1_png.rf.868929ed16b784a193913d60a4cbc062.txt

Processing Ezcaray-
Vozes_pdf_page_2_png.rf.fef088e98e91e58808aeda8644ad827c.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 text, 297.9ms
Speed: 9.0ms preprocess, 297.9ms inference, 1.7ms postprocess per image at shape
```

```
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_2_png.rf.fef088e98e91e58808aeda8644ad827c_textblock_0.jpg
Extracting text from text block 0…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_2_png.rf.fef088e98e91e58808aeda8644ad827c.txt

Processing Ezcaray-
Vozes_pdf_page_3_png.rf.c16fa0e71af0a5b67f369c042445e4a8.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 text, 368.9ms
Speed: 7.7ms preprocess, 368.9ms inference, 1.6ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_3_png.rf.c16fa0e71af0a5b67f369c042445e4a8_textblock_0.jpg
Extracting text from text block 0…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_3_png.rf.c16fa0e71af0a5b67f369c042445e4a8.txt

Processing Ezcaray-
Vozes_pdf_page_4_png.rf.4f9c82f89565fac28f0c83d29d271ea4.jpg…
Detecting text blocks with YOLO…

0: 640x640 2 texts, 401.9ms
Speed: 4.3ms preprocess, 401.9ms inference, 1.3ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_4_png.rf.4f9c82f89565fac28f0c83d29d271ea4_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_4_png.rf.4f9c82f89565fac28f0c83d29d271ea4_textblock_1.jpg
Extracting text from text block 1…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_4_png.rf.4f9c82f89565fac28f0c83d29d271ea4.txt

Processing Ezcaray-
Vozes_pdf_page_5_png.rf.980cbf28c56184e9479183c5ad900f30.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 text, 213.4ms
Speed: 4.8ms preprocess, 213.4ms inference, 1.4ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_5_png.rf.980cbf28c56184e9479183c5ad900f30_textblock_0.jpg
Extracting text from text block 0…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_5_png.rf.980cbf28c56184e9479183c5ad900f30.txt
```

```
Processing Ezcaray-
Vozes_pdf_page_6_png.rf.e1b75d0411708c3ea7106261562b7b4b.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 text, 226.1ms
Speed: 56.7ms preprocess, 226.1ms inference, 2.0ms postprocess per image at
shape (1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_6_png.rf.e1b75d0411708c3ea7106261562b7b4b_textblock_0.jpg
Extracting text from text block 0…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_6_png.rf.e1b75d0411708c3ea7106261562b7b4b.txt

Processing Ezcaray-
Vozes_pdf_page_7_png.rf.07d13d940a3df7f236f776955663c18e.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 text, 384.1ms
Speed: 8.1ms preprocess, 384.1ms inference, 2.0ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_7_png.rf.07d13d940a3df7f236f776955663c18e_textblock_0.jpg
Extracting text from text block 0…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_7_png.rf.07d13d940a3df7f236f776955663c18e.txt

Processing Ezcaray-
Vozes_pdf_page_8_png.rf.1b03ee726bb353fb33dc3e1029906012.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 text, 393.8ms
Speed: 7.8ms preprocess, 393.8ms inference, 1.8ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
Vozes_pdf_page_8_png.rf.1b03ee726bb353fb33dc3e1029906012_textblock_0.jpg
Extracting text from text block 0…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_8_png.rf.1b03ee726bb353fb33dc3e1029906012.txt

Processing Ezcaray-
Vozes_pdf_page_9_png.rf.8f66add5391ae93885aaef7c3a1d94da.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 text, 352.4ms
Speed: 4.5ms preprocess, 352.4ms inference, 1.8ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Ezcaray-
```

```
Vozes_pdf_page_9_png.rf.8f66add5391ae93885aaef7c3a1d94da_textblock_0.jpg
Extracting text from text block 0…
Saved extracted text: output\extracted_texts\Ezcaray-
Vozes_pdf_page_9_png.rf.8f66add5391ae93885aaef7c3a1d94da.txt

Processing Mendo-Principe-
perfecto_pdf_page_1_png.rf.76cf64ef32f300e2c8696a208b0f8f46.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 Image, 2 texts, 367.8ms
Speed: 7.9ms preprocess, 367.8ms inference, 1.5ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_1_png.rf.76cf64ef32f300e2c8696a208b0f8f46_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_1_png.rf.76cf64ef32f300e2c8696a208b0f8f46_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_1_png.rf.76cf64ef32f300e2c8696a208b0f8f46_textblock_2.jpg
Extracting text from text block 2…
Saved extracted text: output\extracted_texts\Mendo-Principe-
perfecto_pdf_page_1_png.rf.76cf64ef32f300e2c8696a208b0f8f46.txt

Processing Mendo-Principe-
perfecto_pdf_page_2_png.rf.54f883ecce6aef501e4ef9c219eacae0.jpg…
Detecting text blocks with YOLO…

0: 640x640 3 texts, 380.5ms
Speed: 7.9ms preprocess, 380.5ms inference, 1.3ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_2_png.rf.54f883ecce6aef501e4ef9c219eacae0_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_2_png.rf.54f883ecce6aef501e4ef9c219eacae0_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_2_png.rf.54f883ecce6aef501e4ef9c219eacae0_textblock_2.jpg
Extracting text from text block 2…
Saved extracted text: output\extracted_texts\Mendo-Principe-
perfecto_pdf_page_2_png.rf.54f883ecce6aef501e4ef9c219eacae0.txt

Processing Mendo-Principe-
perfecto_pdf_page_3_png.rf.ed18a9122c9b8a1c15fa9ea578ea3e50.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 Image, 3 texts, 323.7ms
```

```
Speed: 5.1ms preprocess, 323.7ms inference, 1.6ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_3_png.rf.ed18a9122c9b8a1c15fa9ea578ea3e50_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_3_png.rf.ed18a9122c9b8a1c15fa9ea578ea3e50_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_3_png.rf.ed18a9122c9b8a1c15fa9ea578ea3e50_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_3_png.rf.ed18a9122c9b8a1c15fa9ea578ea3e50_textblock_3.jpg
Extracting text from text block 3…
Saved extracted text: output\extracted_texts\Mendo-Principe-
perfecto_pdf_page_3_png.rf.ed18a9122c9b8a1c15fa9ea578ea3e50.txt

Processing Mendo-Principe-
perfecto_pdf_page_4_png.rf.33729731d0285c3f8f8001a99bdff875.jpg…
Detecting text blocks with YOLO…

0: 640x640 3 texts, 328.7ms
Speed: 7.5ms preprocess, 328.7ms inference, 1.4ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_4_png.rf.33729731d0285c3f8f8001a99bdff875_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_4_png.rf.33729731d0285c3f8f8001a99bdff875_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_4_png.rf.33729731d0285c3f8f8001a99bdff875_textblock_2.jpg
Extracting text from text block 2…
Saved extracted text: output\extracted_texts\Mendo-Principe-
perfecto_pdf_page_4_png.rf.33729731d0285c3f8f8001a99bdff875.txt

Processing Mendo-Principe-
perfecto_pdf_page_5_png.rf.2b3a45fd2c2ba8bb712d6773d5808bae.jpg…
Detecting text blocks with YOLO…

0: 640x640 2 texts, 237.5ms
Speed: 5.1ms preprocess, 237.5ms inference, 1.6ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_5_png.rf.2b3a45fd2c2ba8bb712d6773d5808bae_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_5_png.rf.2b3a45fd2c2ba8bb712d6773d5808bae_textblock_1.jpg
```

```
Extracting text from text block 1…
Saved extracted text: output\extracted_texts\Mendo-Principe-
perfecto_pdf_page_5_png.rf.2b3a45fd2c2ba8bb712d6773d5808bae.txt

Processing Mendo-Principe-
perfecto_pdf_page_6_png.rf.e89bc90c6367ac87e66af14cd6cab73e.jpg…
Detecting text blocks with YOLO…

0: 640x640 1 Image, 4 texts, 318.6ms
Speed: 5.1ms preprocess, 318.6ms inference, 1.5ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_6_png.rf.e89bc90c6367ac87e66af14cd6cab73e_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_6_png.rf.e89bc90c6367ac87e66af14cd6cab73e_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_6_png.rf.e89bc90c6367ac87e66af14cd6cab73e_textblock_2.jpg
Extracting text from text block 2…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_6_png.rf.e89bc90c6367ac87e66af14cd6cab73e_textblock_3.jpg
Extracting text from text block 3…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_6_png.rf.e89bc90c6367ac87e66af14cd6cab73e_textblock_4.jpg
Extracting text from text block 4…
Saved extracted text: output\extracted_texts\Mendo-Principe-
perfecto_pdf_page_6_png.rf.e89bc90c6367ac87e66af14cd6cab73e.txt

Processing Mendo-Principe-
perfecto_pdf_page_7_png.rf.fead3858d524723827122001aeaae940.jpg…
Detecting text blocks with YOLO…

0: 640x640 2 texts, 328.5ms
Speed: 6.0ms preprocess, 328.5ms inference, 1.4ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_7_png.rf.fead3858d524723827122001aeaae940_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_7_png.rf.fead3858d524723827122001aeaae940_textblock_1.jpg
Extracting text from text block 1…
Saved extracted text: output\extracted_texts\Mendo-Principe-
perfecto_pdf_page_7_png.rf.fead3858d524723827122001aeaae940.txt

Processing Mendo-Principe-
perfecto_pdf_page_8_png.rf.28082bf457a0e865ef14f115c3f2c1cf.jpg…
Detecting text blocks with YOLO…
```

```
0: 640x640 1 Image, 2 texts, 266.6ms
Speed: 6.3ms preprocess, 266.6ms inference, 1.6ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_8_png.rf.28082bf457a0e865ef14f115c3f2c1cf_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_8_png.rf.28082bf457a0e865ef14f115c3f2c1cf_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_8_png.rf.28082bf457a0e865ef14f115c3f2c1cf_textblock_2.jpg
Extracting text from text block 2…
Saved extracted text: output\extracted_texts\Mendo-Principe-
perfecto_pdf_page_8_png.rf.28082bf457a0e865ef14f115c3f2c1cf.txt

Processing Mendo-Principe-
perfecto_pdf_page_9_png.rf.2f890e1efaae683789abff5eb203fd6d.jpg…
Detecting text blocks with YOLO…

0: 640x640 2 texts, 341.6ms
Speed: 7.2ms preprocess, 341.6ms inference, 1.3ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_9_png.rf.2f890e1efaae683789abff5eb203fd6d_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Mendo-Principe-
perfecto_pdf_page_9_png.rf.2f890e1efaae683789abff5eb203fd6d_textblock_1.jpg
Extracting text from text block 1…
Saved extracted text: output\extracted_texts\Mendo-Principe-
perfecto_pdf_page_9_png.rf.2f890e1efaae683789abff5eb203fd6d.txt

Processing Paredes-Reglas-
generales_pdf_page_1_png.rf.d4f46dd5fc24f3999b7ea7144a7305e1.jpg…
Detecting text blocks with YOLO…

0: 640x640 3 texts, 266.2ms
Speed: 5.7ms preprocess, 266.2ms inference, 1.4ms postprocess per image at shape
(1, 3, 640, 640)
Saved cropped text block: output\extracted_layouts\Paredes-Reglas-
generales_pdf_page_1_png.rf.d4f46dd5fc24f3999b7ea7144a7305e1_textblock_0.jpg
Extracting text from text block 0…
Saved cropped text block: output\extracted_layouts\Paredes-Reglas-
generales_pdf_page_1_png.rf.d4f46dd5fc24f3999b7ea7144a7305e1_textblock_1.jpg
Extracting text from text block 1…
Saved cropped text block: output\extracted_layouts\Paredes-Reglas-
generales_pdf_page_1_png.rf.d4f46dd5fc24f3999b7ea7144a7305e1_textblock_2.jpg
Extracting text from text block 2…
```

```
Saved extracted text: output\extracted_texts\Paredes-Reglas-
generales_pdf_page_1_png.rf.d4f46dd5fc24f3999b7ea7144a7305e1.txt
```

1.2.7 6. Evaluation Process

1.2.8 Word-Level Accuracy with Partial Matching

- How: For each extracted word, the script finds the closest ground truth word using Levenshtein distance. If the distance is 2 (allowing minor errors like typos), it's a match.

- Calculation: Accuracy = (number of matched words / total extracted words) × 100.

- Why: This measures how well individual words are extracted, tolerating small OCR errors common in historical texts (e.g., 'hola' vs. 'holá').

1.2.9 Levenshtein Similarity

- How: The full extracted text and ground truth text are compared using Levenshtein distance (number of edits needed to transform one into the other). Similarity is calculated as:

```
lev_similarity = 1 - (lev_distance / max_length)
```

#### where `max_length` is the length of the longer text. #### - **Why**: This gives a holistic view of text similarity, accounting for insertions, deletions, and substitutions across the entire text.

1.2.10 Storing and Saving Results

Evaluation details (status, accuracy, similarity, etc.) are stored in a list, converted to a `pandas` DataFrame, and saved to two CSV files: `evaluation.csv` and `combined_results.csv`.

[59]:

```python
print("\nEvaluating the model...")
total_images = len(results)
correct_images = 0
evaluation_details = []

for image_name, data in results.items():
    extracted_words = data.get('extracted_text', [])
    ground_truth = data.get('ground_truth', [])
    raw_ground_truth = data.get('raw_ground_truth', '')

    if not ground_truth:
        print(f"No ground truth for {image_name}, skipping evaluation.")
        continue

    # Calculate word-level accuracy with partial matching
    correct_words = 0
    total_extracted = len([w for w in extracted_words if w])
    missing_words = []
    for word in extracted_words:
        if not word:
            continue
        best_match = min(ground_truth, key=lambda gt:␣
↪levenshtein_distance(word, gt), default="")
        if best_match:
            # Consider a match if the Levenshtein distance is small (e.g., <= 2)
            if levenshtein_distance(word, best_match) <= 2:
                correct_words += 1
            else:
                missing_words.append(word)
        else:
            missing_words.append(word)

    # Calculate Levenshtein distance for the full text
    extracted_full = " ".join(extracted_words)
    ground_truth_full = " ".join(ground_truth)
    lev_distance = levenshtein_distance(extracted_full, ground_truth_full)
    max_length = max(len(extracted_full), len(ground_truth_full))
    lev_similarity = 1 - (lev_distance / max_length) if max_length > 0 else 0

    # Word-level accuracy
    word_accuracy = (correct_words / total_extracted) * 100 if total_extracted␣
↪> 0 else 0

    # Consider the image "correct" if word accuracy is above a threshold (e.g.,␣
↪50%)
    threshold = 50  # Lowered threshold
    if word_accuracy >= threshold:
        correct_images += 1
        status = f"Correct (Word Accuracy: {word_accuracy:.2f}%, Levenshtein␣
↪Similarity: {lev_similarity:.2f})"
    else:
        status = f"Incorrect (Word Accuracy: {word_accuracy:.2f}%, Levenshtein␣
↪Similarity: {lev_similarity:.2f}, Missing: {', '.join(missing_words)})"

    evaluation_details.append({
        'Image': image_name,
        'Status': status,
        'Extracted Text': " ".join(extracted_words),
        'Ground Truth Text': raw_ground_truth,
        'Missing Words': ", ".join(missing_words),
        'Word Accuracy (%)': word_accuracy,
        'Levenshtein Similarity': lev_similarity
    })
```

```
Evaluating the model…
No ground truth for Constituciones-sinodales-
Calahorra-1602_pdf_page_1_png.rf.224a39c994a0ebe3c052aee74a36d165, skipping
evaluation.
No ground truth for Constituciones-sinodales-
Calahorra-1602_pdf_page_2_png.rf.59b2f2b9ee344d9106aefa4598d78084, skipping
evaluation.
No ground truth for Constituciones-sinodales-
Calahorra-1602_pdf_page_4_png.rf.e4a6820aadf62a1ce5c619220cb7d863, skipping
evaluation.
No ground truth for Constituciones-sinodales-
Calahorra-1602_pdf_page_5_png.rf.a3e5c87bfbd3cf34c01ca0fa402799b0, skipping
evaluation.
No ground truth for Constituciones-sinodales-
Calahorra-1602_pdf_page_6_png.rf.1b20a833bc4c8b3c040818f65e0d5223, skipping
evaluation.
```

```
[ ]:
```

1.2.11 Accuracy

The overall accuracy of the model is 81.25%

Average Word-Level = 91.00515557 %

Average Levenshtein Similarity = 0.704979

1.3 Overview of the Evaluation Process

The evaluation section of your code measures how well the extracted text matches the ground truth text for each image. It uses two metrics: 1. **Word-Level Accuracy**: Measures the percentage of extracted words that match ground truth words, allowing for small differences (using Levenshtein distance). 2. **Levenshtein Similarity**: Measures the overall similarity between the full extracted text and ground truth text.

The **accuracy** of the model (reported as a percentage at the end) is based on the number of images where the word-level accuracy exceeds a threshold (50%). Let's focus on how this word-level accuracy is calculated, as it directly influences the overall accuracy.

1.4 Step-by-Step Explanation of Accuracy Calculation

1.4.1 1. Extracted and Ground Truth Words

For each image, the script has: - `extracted_words`: A list of words from the OCR output, after cleaning with `clean_historical_text`. - `ground_truth`: A list of words from the ground truth text, also cleaned.

These lists are stored in the `results` dictionary for each image:

```
extracted_words = data.get('extracted_text', [])
ground_truth = data.get('ground_truth', [])
```

1.4.2 2. Word-Level Accuracy with Partial Matching

The script calculates word-level accuracy by comparing each extracted word to the ground truth words, allowing for small differences using the Levenshtein distance.

- **Filter Empty Words**:
  - `total_extracted = len([w for w in extracted_words if w])`: Counts non-empty words in `extracted_words`. Empty strings (e.g., from OCR errors) are excluded to avoid skewing the count.
  - **Why**: Ensures only meaningful words contribute to the accuracy calculation.
- **Find Best Match**:
  - `best_match = min(ground_truth, key=lambda gt: levenshtein_distance(word, gt), default="")`: Finds the ground truth word with the smallest Levenshtein distance to the extracted word.
  - **Levenshtein Distance**: Measures the minimum number of single-character edits (insertions, deletions, substitutions) needed to transform one word into another. For example, `levenshtein_distance("cat", "hat") = 1` (one substitution: c → h).
  - **Why**: Allows partial matching, so small OCR errors (e.g., “hola” vs. “holá”) are still considered correct.
- **Determine Correctness**:
  - `if best_match and levenshtein_distance(word, best_match) <= 2`: A word is considered correct if its best match in the ground truth has a Levenshtein distance of 2 or less.
  - **Threshold of 2**: Allows for minor errors (e.g., one or two character differences). For example:
    - “hola” vs. “holá” (distance = 1, correct).
  - **Why**: Historical texts and OCR often introduce small errors (e.g., accented characters, misread letters). A threshold of 2 balances leniency and accuracy.
  - If correct, `correct_words += 1`; otherwise, the word is added to `missing_words` for reporting.

1.5 Role of Levenshtein Similarity

- **Purpose**: Measures overall text similarity, complementing word-level accuracy by capturing structural differences (e.g., missing or extra phrases).
- **Why Not Used in Accuracy?**: It’s a broader metric, less granular than word-level accuracy, and is included in the evaluation report for context.

[60]:

```
accuracy = (correct_images / total_images) * 100 if total_images > 0 else 0
print(f"\nEvaluation Summary:")

print(f"Accuracy: {accuracy:.2f}%")

# Display detailed evaluation
eval_df = pd.DataFrame(evaluation_details)
print("\nDetailed Evaluation:")
```

```python
display(eval_df)

# Step 7: Save evaluation results to CSV
eval_df.to_csv(EVALUATION_CSV_PATH, index=False, encoding='utf-8')
print(f"\nSaved evaluation results to {EVALUATION_CSV_PATH}")

# Step 8: Save a new combined CSV with evaluation and transcriptions
eval_df.to_csv(NEW_CSV_PATH, index=False, encoding='utf-8')
print(f"Saved combined results to {NEW_CSV_PATH}")

# Optional: Visualize an example with bounding boxes
if image_files:
    example_image = image_files[0]
    example_image_path = os.path.join(IMAGE_DIR, example_image)
    example_image_rgb = cv2.cvtColor(cv2.imread(example_image_path), cv2.
 ↪COLOR_BGR2RGB)

    yolo_results = yolo_model(example_image_rgb, conf=0.3)
    for result in yolo_results:
        boxes = result.boxes.xyxy.cpu().numpy()
        for box in boxes:
            x1, y1, x2, y2 = map(int, box)
            cv2.rectangle(example_image_rgb, (x1, y1), (x2, y2), (255, 0, 0), 2)

    plt.figure(figsize=(10, 8))
    plt.imshow(example_image_rgb)
    plt.title(f"Example Image with Detected Text Blocks: {example_image}")
    plt.axis('off')
    plt.show()
```

```
Evaluation Summary:
Accuracy: 81.25%

Detailed Evaluation:
                                                Image  \
0   Buendia-Instruccion_pdf_page_1_png.rf.31aa8df6…
1   Buendia-Instruccion_pdf_page_2_png.rf.3dfe8354…
2   Buendia-Instruccion_pdf_page_3_png.rf.1507d0da…
3   Buendia-Instruccion_pdf_page_4_png.rf.e61e9006…
4   Buendia-Instruccion_pdf_page_5_png.rf.e356bea2…
5   Buendia-Instruccion_pdf_page_6_png.rf.4d6abc76…
6   Ezcaray-Vozes_pdf_page_10_png.rf.e098b341498eb…
7   Ezcaray-Vozes_pdf_page_11_png.rf.86e6c9ec0da33…
8   Ezcaray-Vozes_pdf_page_1_png.rf.868929ed16b784…
9   Ezcaray-Vozes_pdf_page_2_png.rf.fef088e98e91e5…
10  Ezcaray-Vozes_pdf_page_3_png.rf.c16fa0e71af0a5…
```

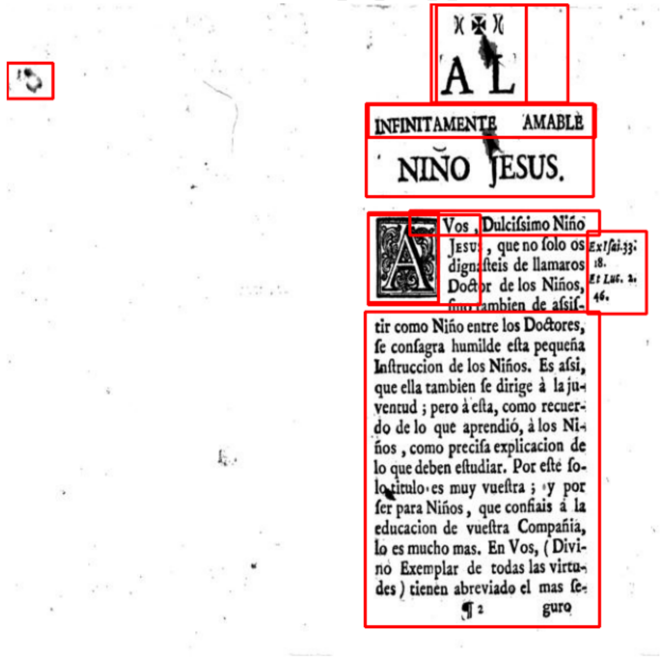
```
11  Ezcaray-Vozes_pdf_page_4_png.rf.4f9c82f89565fa…
12  Ezcaray-Vozes_pdf_page_5_png.rf.980cbf28c56184…
13  Ezcaray-Vozes_pdf_page_6_png.rf.e1b75d0411708c…
14  Ezcaray-Vozes_pdf_page_7_png.rf.07d13d940a3df7…
15  Ezcaray-Vozes_pdf_page_8_png.rf.1b03ee726bb353…
16  Ezcaray-Vozes_pdf_page_9_png.rf.8f66add5391ae9…
17  Mendo-Principe-perfecto_pdf_page_1_png.rf.76cf…
18  Mendo-Principe-perfecto_pdf_page_2_png.rf.54f8…
19  Mendo-Principe-perfecto_pdf_page_3_png.rf.ed18…
20  Mendo-Principe-perfecto_pdf_page_4_png.rf.3372…
21  Mendo-Principe-perfecto_pdf_page_5_png.rf.2b3a…
22  Mendo-Principe-perfecto_pdf_page_6_png.rf.e89b…
23  Mendo-Principe-perfecto_pdf_page_7_png.rf.fead…
24  Mendo-Principe-perfecto_pdf_page_8_png.rf.2808…
25  Mendo-Principe-perfecto_pdf_page_9_png.rf.2f89…
26  Paredes-Reglas-generales_pdf_page_1_png.rf.d4f…

                                               Status  \
0   Correct (Word Accuracy: 97.14%, Levenshtein Si…
1   Correct (Word Accuracy: 96.37%, Levenshtein Si…
2   Correct (Word Accuracy: 91.63%, Levenshtein Si…
3   Correct (Word Accuracy: 97.91%, Levenshtein Si…
4   Correct (Word Accuracy: 98.42%, Levenshtein Si…
5   Correct (Word Accuracy: 96.04%, Levenshtein Si…
6   Correct (Word Accuracy: 97.52%, Levenshtein Si…
7   Correct (Word Accuracy: 96.34%, Levenshtein Si…
8   Correct (Word Accuracy: 93.48%, Levenshtein Si…
9   Correct (Word Accuracy: 95.62%, Levenshtein Si…
10  Correct (Word Accuracy: 98.11%, Levenshtein Si…
11  Correct (Word Accuracy: 85.16%, Levenshtein Si…
12  Correct (Word Accuracy: 85.71%, Levenshtein Si…
13  Correct (Word Accuracy: 91.55%, Levenshtein Si…
14  Correct (Word Accuracy: 95.95%, Levenshtein Si…
15  Correct (Word Accuracy: 95.62%, Levenshtein Si…
16  Correct (Word Accuracy: 92.36%, Levenshtein Si…
17  Correct (Word Accuracy: 81.07%, Levenshtein Si…
18  Correct (Word Accuracy: 99.09%, Levenshtein Si…
19  Correct (Word Accuracy: 95.36%, Levenshtein Si…
20  Incorrect (Word Accuracy: 42.51%, Levenshtein …
21  Correct (Word Accuracy: 91.29%, Levenshtein Si…
22  Correct (Word Accuracy: 91.11%, Levenshtein Si…
23  Correct (Word Accuracy: 94.08%, Levenshtein Si…
24  Correct (Word Accuracy: 89.67%, Levenshtein Si…
25  Correct (Word Accuracy: 89.74%, Levenshtein Si…
26  Correct (Word Accuracy: 78.29%, Levenshtein Si…

                                       Extracted Text  \
0   1e m ee dg __jw hr tir como niño entre los doé…
```

```
1   viísimos abrazos dichosa edad msito que o5 mer…
2   de orden del nuftre señor doñ friz cifco de ba…
3   cabaliero muy santos por rodo lo qual 4 mas de…
4   hemos de dár en otro mas severo eribuz mal qui…
5   de la obra a devocion y aseño que delde mis l …
6   en los caxones de palacio dóride por mis pecad…
7   frantonio de excaray las prensas efto es dar v…
8   eyo cupado en cl exercicio de __xfº k de las m…
9   a eftos dos nombres dn mifterio sas interprera…
10  leñoa elombro sacaron el razimo de la tierra d…
11  diante sus virrudes en la bienaventn ranga en …
12  birrevacuavi que evant parveli quando vnohazc …
13  diromegua se dezia en elte nuevo mú do y que a…
14  porque efta se acabey se lean en eita corte ef…
15  ecteri timoren babeant docctrina es de san pah…
16  guardo el sobreefcrito de vi a la cabeza de la…
17  eao m ne q ea egpnda vec asirisimo señor salen…
18  geado el sirlo lagrándo diguamente en nueftro …
19  a uy sidad de dalamanea oxn comilion del uluft…
20  t acumbre la fpctacion oue es alaja muy eftima…
21  licencia del ordinario d0n iuanperez delgado p…
22  berrs e orden y comision de v ahevifto coy meo…
23  hg semper sidier refti por lo qual preguntado …
24  jamsrie viendo obleruado en la continua leccio…
25  nellano eltá expuelto 1mas censira porgque te …
26  para los que aprendicrenefte artz y quisieren …

                                       Ground Truth Text  \
0   Vos , Dulcifsimo Niño\nJESUS , que no folo os …
1   guro diffeño de su edad : la Reli-\ngion para …
2   crianza de la Niñez . Afsi sea;\nDivinifsimo N…
3   Antonio Codorniu , de la\nCompañia de Jeſus \n…
4   hemos de dár en otro mas ſevero tribu-\nnal . …
5   MOTIVO DEL AUTHOR , Y RAZON\nde la Obra .\n\nA…
6   en los caxones de Palacio , donde ( por\nmis p…
7   las prenſas ( eſto es dar vozes los mol-\ndes …
8   Cupado en el exercicio\nde las Miffiones en el…
9   A eſtos dos nombres dan miſterio-\nſas interpr…
10  leño a el ombro facaron el razimo de\nla tierr…
11  que antes examinaron , repreſentacion\nde la g…
12  vir.evacuavi que erant parvuli\nQuando vno haz…
13  dito ( ſegun ſe dezia ) en eſte nuevo mũ-\ndo …
14  nacidas de la profanidad .\nPorque eſta ſe aca…
15  ceteri timorem habeant . Doctrina es de San\nP…
16  bayna del ſilencio , les ſervirà de reſ-\nguar…
17  AL\nILLVSTRISSIMO\nSEÑOR\nDON \nALONSO\nPEREZ\…
18  geado el ſerlo s logrando dignamente en nuestr…
19  APROBACION\nDel Doctor D.Francisco de Puga , y…
```

```
20  r\ni\ne\nd\na\nd\n \nd\ne\nl\n \na\nf\nu\nm\np…
21  videatur non curaffe . No ay en todo el libro …
22  APROBACION\nDel Reuerendiſsimo Padre Maeſtro F…
23  filij ſemper fidi , & recti . Por lo qual preg…
24  VIENDO obſeruado en la continua leccion de\nva…
25  ſtellano , eſtå expueſto à mas cenſura , por q…
26  Para los que aprendieren eſte Arte , y quiſier…

                                        Missing Words  Word Accuracy (%)  \
0                          __jw, lagituloes, inennití          97.142857   
1   exbe, urodiseño, paracon, afsiltéciad, tarque,…          96.369637   
2   nuftre, baliero, sastiftán, luftrifsimo, geron…          91.627907   
3         conciertoque, muefras, bídn, 15salil, 1cmim          97.907950   
4    reála, artísio, aciertohan, 1í_fcn, afsilosiento          98.417722   
5   infruirles, lm_sn, añaroa, 2nfraccion, ctrisio…          96.039604   
6         dóride, necefflidad, poderdezir, vslguesabe          97.515528   
7                 ilegaransi, luftridimo, lluftrisimo          96.341463   
8   __xfº, recibivna, apoftolicatuve, midbli, guci…          93.478261   
9   sasorcorazonseñor, grmdc, corezanociory, alisa…          95.620438   
10                 promiftiosombray, deffco, eseftoes          98.113208   
11  moysesque, frurohallo, ifraeliras, intentara, …          85.161290   
12  vnohazc, poreftarlo, parahallar, susajos, vs81…          85.714286   
13  diromegua, queyoera, predicadorbaftan, magefta…          91.549296   
14  pongoala, nombretendrin, quelos, asimilanalos,…          95.945946   
15  bienlos, eftoslos, logreseseñor, salganentodas…          95.620438   
16  llamdchrifto, procinxitje, sedemmuda, auzojhba…          92.361111   
17  asirisimo, parasormaron, adinisivos, apzair, e…          81.065089   
18                                            grachii          99.090909   
19  sidad, uluftrisimo, sagradacomo, prosanaantes,…          95.357143   
20  acumbre, fpctacion, alaja, eftimable, encumbre…          42.514970   
21  iuanperez, salamancadel, eccpor, presentepor, …          91.290323   
22  berrs, ahevifto, euyotinle, perseciosy, 2dinis…          91.111111   
23  disereros, seisiezs, monimentaintetigens, dieu…          94.076655   
24  jamsrie, suarndo, psicc, pertceto, efcridió, p…          89.667897   
25  porgque, émionde, élter, parencesisde, larinaa…          89.743590   
26  aprendicrenefte, meparcoe, ticred, bafbnte, mg…          78.294574   

    Levenshtein Similarity  
0                 0.689034  
1                 0.270073  
2                 0.402259  
3                 0.740968  
4                 0.930711  
5                 0.607185  
6                 0.941606  
7                 0.479167  
8                 0.490998  
9                 0.889820  
```

```
10                  0.946136
11                  0.419839
12                  0.692308
13                  0.925245
14                  0.908884
15                  0.949112
16                  0.829519
17                  0.287701
18                  0.923577
19                  0.735952
20                  0.514986
21                  0.618373
22                  0.666041
23                  0.869707
24                  0.848039
25                  0.728980
26                  0.721467

Saved evaluation results to output\evaluation_results.csv
Saved combined results to output\combined_results.csv

0: 640x640 5 Images, 5 texts, 77.7ms
Speed: 2.4ms preprocess, 77.7ms inference, 0.6ms postprocess per image at shape
(1, 3, 640, 640)
```

Example Image with Detected Text Blocks: Buendia-Instruccion_pdf_page_1_png.rf.31aa8df6b8ac0193ef53ed053f55ba65.jpg



AL

INFINITAMENTE AMABLE

NIÑO JESUS.

A Vos, Dulciſsimo Niño Jesus, que no ſolo os dignaſteis de llamaros Doctor de los Niños, ſino tambien de aſsiſtir como Niño entre los Doctores, ſe conſagra humilde eſta pequeña Inſtruccion de los Niños. Es aſsi, que ella tambien ſe dirige à la juventud; pero à eſta, como recuerdo de lo que aprendió, à los Niños, como preciſa explicacion de lo que deben eſtudiar. Por eſte ſolo titulo es muy vueſtra; y por ſer para Niños, que confiais à la educacion de vueſtra Compañia, lo es mucho mas. En Vos, (Divino Exemplar de todas las virtudes) tienen abreviado el mas ſeguro

Ex Iſai. 33. 18.

Et Luc. 2. 46.

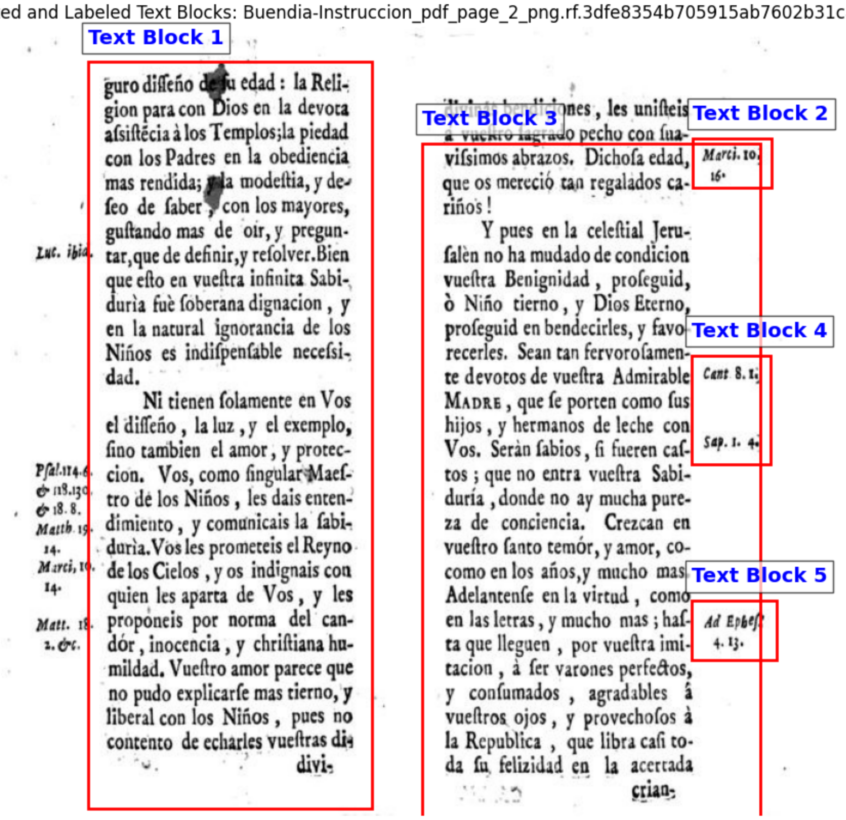
¶ 2 guro

[62]:

```
if image_files:
    # Select an example image (e.g., the second image in the dataset)
    example_image = image_files[1]
    example_image_path = os.path.join(IMAGE_DIR, example_image)
    example_image_rgb = cv2.cvtColor(cv2.imread(example_image_path), cv2.
 ↪COLOR_BGR2RGB)

    # Step 1: Detect text blocks with YOLO
    print(f"\nVisualizing text blocks and extracted text for {example_image}...
 ↪")
    yolo_results = yolo_model(example_image_rgb, conf=0.5)  # Adjusted␣
 ↪confidence threshold from 0.3 to 0.5

    # Step 2: Extract bounding boxes and prepare for visualization
    text_blocks = []
    for result in yolo_results:
        boxes = result.boxes.xyxy.cpu().numpy()
        for idx, box in enumerate(boxes):
            x1, y1, x2, y2 = map(int, box)
            # Filter out small or invalid boxes
            if (x2 - x1) > 50 and (y2 - y1) > 20:  # Adjust thresholds based on␣
 ↪your images
                text_block = example_image_rgb[y1:y2, x1:x2]  # Crop the text␣
 ↪block in RGB
                text_blocks.append((text_block, (x1, y1, x2, y2)))

    # Step 3: Sort text blocks by y-coordinate (top to bottom) for reading order
    text_blocks.sort(key=lambda b: b[1][1])

    # Step 4: Plot the image with labeled text blocks
    plt.figure(figsize=(12, 10))
    plt.imshow(example_image_rgb)

    # Add bounding boxes and labels
    for idx, (_, (x1, y1, x2, y2)) in enumerate(text_blocks):
        # Draw the bounding box
        rect = plt.Rectangle((x1, y1), x2 - x1, y2 - y1, linewidth=2,␣
 ↪edgecolor='red', facecolor='none')
        plt.gca().add_patch(rect)
        # Add the label (e.g., "Text Block 1") above the box
        label = f"Text Block {idx + 1}"
        plt.text(x1, y1 - 15, label, color='blue', fontsize=14, weight='bold',
                 bbox=dict(facecolor='white', alpha=0.7))

    plt.title(f"Image with Detected and Labeled Text Blocks: {example_image}")
    plt.axis('off')
    plt.show()
    # Step 5: Extract text from each text block using Tesseract and display the␣
↪results
    print("\nExtracted Text for Each Text Block:")
    for idx, (text_block, (x1, y1, x2, y2)) in enumerate(text_blocks):
        # Preprocessing for Tesseract
        # Resize the image to improve small text recognition
        text_block_resized = cv2.resize(text_block, None, fx=2, fy=2,␣
↪interpolation=cv2.INTER_CUBIC)
        gray = cv2.cvtColor(text_block_resized, cv2.COLOR_RGB2GRAY)
        # Denoise the image
        adjusted = cv2.medianBlur(gray, 3)
        # Increase contrast
        alpha = 1.5  # Contrast control (1.0-3.0)
        beta = 0     # Brightness control (0-100)
        adjusted = cv2.convertScaleAbs(adjusted, alpha=alpha, beta=beta)
        # Apply adaptive thresholding for uneven lighting
        thresh = cv2.adaptiveThreshold(adjusted, 255, cv2.
↪ADAPTIVE_THRESH_GAUSSIAN_C,
                                       cv2.THRESH_BINARY, 11, 2)

        # Deskew the image
        coords = np.column_stack(np.where(thresh > 0))
        if len(coords) > 0:  # Ensure there are enough points to deskew
            angle = cv2.minAreaRect(coords)[-1]
            if angle < -45:
                angle = -(90 + angle)
            else:
                angle = -angle
            (h, w) = thresh.shape[:2]
            center = (w // 2, h // 2)
            M = cv2.getRotationMatrix2D(center, angle, 1.0)
            thresh = cv2.warpAffine(thresh, M, (w, h), flags=cv2.INTER_CUBIC,
                                    borderMode=cv2.BORDER_REPLICATE)

        # Extract text with Tesseract
        tesseract_config = '--oem 3 --psm 3 -l spa'  # Adjusted config; replace␣
↪with your original if custom
        extracted_text = pytesseract.image_to_string(thresh,␣
↪config=tesseract_config).strip()

        # Post-process text (e.g., replace long "s" with regular "s" for␣
↪historical text)
        extracted_text = extracted_text.replace('f', 's')

        # Display the extracted text for this text block
        print(f"\nText Block {idx + 1} (Coordinates: ({x1}, {y1}, {x2}, {y2})):
↪")
        print(f"Extracted Text:\n{extracted_text}")
```

```
Visualizing text blocks and extracted text for Buendia-
Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74.jpg…

0: 640x640 5 texts, 144.6ms
Speed: 5.0ms preprocess, 144.6ms inference, 1.5ms postprocess per image at shape
(1, 3, 640, 640)
```

Image with Detected and Labeled Text Blocks: Buendia-Instruccion_pdf_page_2_png.rf.3dfe8354b705915ab7602b31ca902f74.jpg


Text Block 1
Text Block 3
Text Block 2
Text Block 4
Text Block 5

guro diſſeño de ſu edad: la Religion para con Dios en la devota aſsiſtẽcia à los Templos;la piedad con los Padres en la obediencia mas rendida; y la modeſtia, y deſeo de ſaber, con los mayores, guſtando mas de oir, y preguntar,que de definir,y reſolver.Bien que eſto en vueſtra infinita Sabiduria fuè ſoberana dignacion, y en la natural ignorancia de los Niños es indiſpenſable neceſsidad.

Luc. ibid.

Ni tienen ſolamente en Vos el diſſeño, la luz, y el exemplo, ſino tambien el amor, y proteccion. Vos, como ſingular Maeſtro de los Niños, les dais entendimiento, y comunicais la ſabiduria.Vos les prometeis el Reyno de los Cielos, y os indignais con quien les aparta de Vos, y les proponeis por norma del candór, inocencia, y chriſtiana humildad. Vueſtro amor parece que no pudo explicarſe mas tierno, y liberal con los Niños, pues no contento de echarles vueſtras di-

divi-

Pſal.114.6. & 118.130. & 18. 8. Matth. 19. 14. Marci, 10. 14.

Matt. 18. 2. &c.

divinas bendiciones, les uniſteis à vueſtro ſagrado pecho con ſuaviſsimos abrazos. Dichoſa edad, que os mereció tan regalados cariños!

Marci. 10. 16.

Y pues en la celeſtial Jeruſalèn no ha mudado de condicion vueſtra Benignidad, proſeguid, ò Niño tierno, y Dios Eterno, proſeguid en bendecirles, y favorecerles. Sean tan fervoroſamente devotos de vueſtra Admirable Madre, que ſe porten como ſus hijos, y hermanos de leche con Vos. Seràn ſabios, ſi fueren caſtos; que no entra vueſtra Sabiduría, donde no ay mucha pureza de conciencia. Crezcan en vueſtro ſanto temór, y amor, cocomo en los años,y mucho mas Adelantenſe en la virtud, como en las letras, y mucho mas; haſta que lleguen, por vueſtra imitacion, à ſer varones perfectos, y conſumados, agradables à vueſtros ojos, y provechoſos à la Republica, que libra caſi toda ſu felizidad en la acertada crian-

crian-

Cant. 8. 1.

Sap. 1. 4.

Ad Epheſ. 4. 13.

```
Extracted Text for Each Text Block:

Text Block 1 (Coordinates: (70, 28, 301, 634)):
Extracted Text:
|

duria fue foberana dignacion , y
en la natural ignorancia de los
Niños es indifpenfable necefsi-
```

```
dad.

Ni cienen folamente en Vos
el diffeño , la luz , y el excmplo,
fino tambien el amor, y protec-
cion. Vos, como fingularMaef-
tro de los Niños , les dais enten-
dimicuro , y comunicais la fabi-

- duria,Vos les prometeis el Reyno

de los Cielos . y os indignaís con

Text Block 2 (Coordinates: (561, 90, 625, 130)):
Extracted Text:
farci. 10
16*

Text Block 3 (Coordinates: (341, 94, 616, 640)):
Extracted Text:
- - _ _ - R -
profeguid en bendecirles, y favo-
recerles. Scan tan fervorolamen-
te devotos de vueltra Admirable
Mapre, que fe porten como fus
hijos , y hermanos de leche con
Vos. Serán fabios, i fueren caf-
tos ; que no entra vueltra Sabi-
duría , donde no ay mucha pure-
za de conciencia. Crezcan en
vueltro fanto temór, y amor, co-
como en los años,y mucho mas.
Adelantenfe en la virtud , como

en las letras , y mucho mas ; haf-
ea aue llenuen - nar vneltra tmi.

Cant 8.1;

Sap. 1. de

AEA comprmzzm---amm-.

4.13.

Text Block 4 (Coordinates: (560, 266, 624, 354)):
Extracted Text:
$AE 0. de
```

```
$ap. l. de

Text Block 5 (Coordinates: (560, 465, 629, 513)):
Extracted Text:
4d ENSeS
4 13.
```

1.6 Visualization

As you can see the YOLO model is great at identifying the text blocks. It does has problem in identifying the text blocks near the margins.

For the image, the script:

- Runs YOLO to detect text blocks.

- Draws red bounding boxes around them.

- Extracts the text from the bonding box.

- Displays the annotated image using Matplotlib.

- Displays the extracted text.

This helps verify visually whether the text blocks were detected correctly.

1.7 Summary

This code: - **Detects** text blocks with YOLO. - **Extracts** text using Tesseract with `spa.traineddata` for Spanish accuracy. - **Evaluates** performance with word accuracy and Levenshtein similarity. - **Handles Text**: Cleans text to address historical or encoding quirks. - **Visualizes** results for verification.

[ ]:

[ ]: