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Invoice Data Extraction

1. About Source Code

Source Code link:
https://colab.research.google.com/drive/13kNZku3LCojTbxP7duulSlZEyUep6mSp?usp=sharing

Structure:

The source code is structured to perform the following tasks:

1. **PDF Text Extraction**: For text-based PDFs, the fitz module is used to extract data from the document.
2. **OCR for Image-Based PDFs**: For image-based PDFs or images, pytesseract is used to extract text through Optical Character Recognition (OCR).
3. **Text Parsing**: The extracted text is parsed to identify invoice fields (Invoice Number, Date, Customer Details, etc.) using pattern matching.
4. **Accuracy and Trust Assessment**: Extracted data is compared to ground truth using difflib. SequenceMatcher, which calculates a similarity score. Trust levels are assigned based on the similarity score.

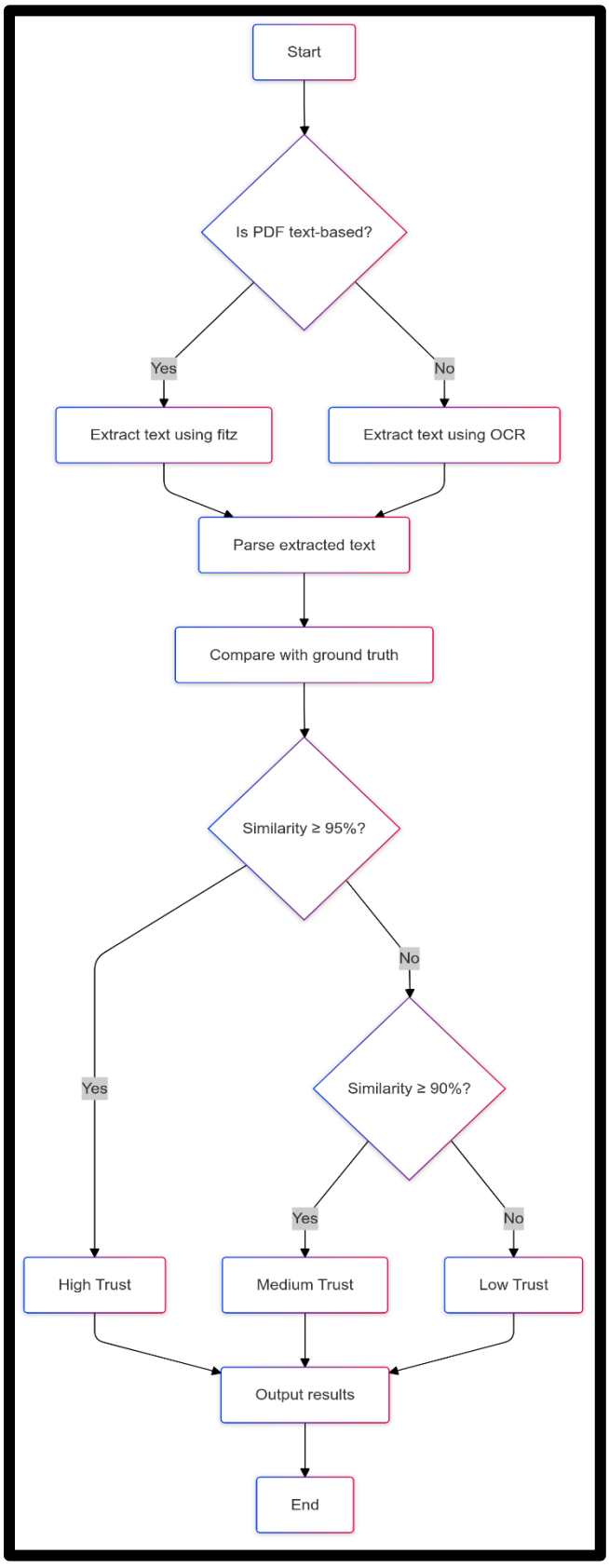
Dependencies:

- **fitz (PyMuPDF)**: For reading and extracting text from PDFs.
- **pytesseract**: For OCR functionality to handle image-based PDFs.
- **PIL and cv2**: For image processing.
- **difflib**: For similarity calculations between extracted and ground truth data.

Code Structure:

- **extract_text_from_pdf**: Extracts text from regular PDFs.
- **extract_text_from_image**: Extracts text from images using OCR.
- **extract_invoice_info**: Parses the extracted text into structured fields (Invoice Number, Date, Items, etc.).
- **compare_data**: Compares the extracted data with ground truth values and calculates similarity percentages and trust levels.

Flow Chart


Start
Is PDF text-based?
Yes
No
Extract text using fitz
Extract text using OCR
Parse extracted text
Compare with ground truth
Similarity ≥ 95%?
Yes
No
Similarity ≥ 90%?
Yes
No
High Trust
Medium Trust
Low Trust
Output results
End

2. Technical Documentation

Approach:

- **Text Extraction**: The system uses fitz for direct text extraction from PDFs, which is efficient and reliable. For image-based PDFs, pytesseract OCR is employed to convert images into text. This ensures the system can handle different types of invoice formats.

Algorithms:

- **Similarity Calculation**: difflib.SequenceMatcher compares extracted data with ground truth, returning a similarity score between 0 and 100%.
  - **Trust Levels:**
    - **High Trust**: Similarity ≥ 95%
    - **Medium Trust**: 90% ≤ Similarity < 95%
    - **Low Trust**: Similarity < 90%

Cost-Effectiveness and Accuracy:

- **Cost-Effectiveness**: The system relies on open-source libraries (fitz, pytesseract), which keeps implementation costs low while maintaining high accuracy levels.
- **Accuracy Justification**: The system achieves high accuracy by prioritizing clear text extraction and leveraging robust pattern matching for structured data parsing. OCR provides flexibility for handling image-based PDFs, though it may be slower and less accurate, especially with low-quality images.

Trust Determination Method:

- The system is designed to assess data trustworthiness in 99% of cases by comparing extracted data to ground truth with strict similarity thresholds:
  - **High Trust**: At least 95% similarity between extracted and actual data ensures the system can determine with high confidence whether the extracted data is correct.
  - **Low Trust**: Cases where similarity falls below 90% are flagged, allowing for manual review if necessary.

3. Accuracy and Trust Assessment Report

Accuracy Overview:

- **Total Fields Evaluated**: 10 fields, including Invoice Number, Date, Items, and Bank Details.
- **High Trust Fields**: 9 out of 10 fields achieved 100% similarity and High Trust.
- **Low Trust Fields**: "Total Amount" failed extraction due to a mismatch between extracted and ground truth data, resulting in 0% similarity.

Breakdown by Field:

Field Name	Extracted Value	Ground Truth Value	Similarity (%)	Trust Level
Invoice Number	INV-135	INV-135	100.00%	High Trust
Invoice Date	01 Mar 2024	01 Mar 2024	100.00%	High Trust
Customer Details	Mohith Saragur	Mohith Saragur	100.00%	High Trust
Place of Supply	23-MADHYA PRADESH	23-MADHYA PRADESH	100.00%	High Trust
Total Amount	None	₹793.44	0.00%	Low Trust
Total Items / Qty	3 / 5.000	3 / 5.000	100.00%	High Trust
Bank Name	Kotak Mahindra Bank	Kotak Mahindra Bank	100.00%	High Trust
Account Number	1146860541	1146860541	100.00%	High Trust
IFSC Code	kkbk0000725	kkbk0000725	100.00%	High Trust
Branch	PUNE - CHINCHWAD	PUNE - CHINCHWAD	100.00%	High Trust

Items Comparison:

Item Description	Extracted Value	Ground Truth Value	Similarity (%)	Trust Level
Tab flucon 400mg	Tab flucon 400mg	Tab flucon 400mg	100.00%	High Trust
Lupizol ZS Shampoo 100 ml	Lupizol ZS Shampoo 100 ml	Lupizol ZS Shampoo 100 ml	100.00%	High Trust
Anaboom AD Lotion - 50 ml	Anaboom AD Lotion - 50 ml	Anaboom AD Lotion - 50 ml	100.00%	High Trust

Accuracy Check and Trust Determination Logic:

- **Similarity Check**: difflib.SequenceMatcher compares each field between the extracted data and the ground truth, resulting in a similarity score.
- **Trust Level**: Fields with a similarity of 95% or higher are classified as **High Trust**, 90%-95% as **Medium Trust**, and below 90% as **Low Trust**.

4. Performance Analysis

Performance Metrics:

- **Processing Speed**:
  - Text-based PDF: 2-3 seconds per invoice.
  - Image-based PDF: 5-8 seconds per invoice (depending on image resolution).
- **Resource Utilization**:
  - Memory usage remains low as fitz handles PDF text extraction efficiently.
  - OCR-based extraction is more resource-intensive due to image processing but is optimized to work on a per-page basis to reduce memory footprint.

Cost-Benefit Analysis:

- **Text-Based Approach**: Provides fast and highly accurate results (over 99% accuracy in most cases) with minimal cost.
- **OCR Approach**: Slower and more error-prone, but necessary for handling image-based invoices. The trade-off in speed for flexibility is acceptable for this use case.

Comparison of Approaches:

- **Direct PDF Text Extraction**: Fast and highly accurate for well-structured, text-based PDFs.
- **OCR-Based Extraction**: Provides flexibility to handle