Motivation

In Bangladesh, land ownership documents like Khotiyan are often stored as scanned images or physical copies. These records are vulnerable to fraud, forgery, and data loss, especially in legal disputes. However, extracting Bangla text from such documents is challenging due to the complexity of the Bangla script and low-quality scans.

This project aims to solve that problem by using OCR with image preprocessing to accurately detect and extract text from land record images. This can support fraud detection, digitization, and secure storage of official documents.

Background

Land ownership in Bangladesh is often verified using physical documents such as Khotiyan, which are typically handwritten or printed in Bangla and stored as scanned images. These records are crucial in legal, governmental, and property-related matters. However, manual verification is time-consuming, error-prone, and vulnerable to fraud.

Optical Character Recognition (OCR) provides a digital solution by converting images of text into machine-readable form. While OCR for English and other Latin-based languages has seen significant progress, Bangla OCR still faces challenges due to the script’s complex structure, ligatures, and variations in fonts and quality of historical records.

Recent advancements in image preprocessing, machine learning, and language-specific OCR tools like Tesseract (with Bangla language support) have made it possible to extract text from low-quality documents. Applying these techniques to Bangla land records can help automate text detection, enable digital verification, and support fraud detection in land management systems.

Objectives

The primary objective of this study is to develop an automated system for detecting and extracting Bangla text from scanned land record images to support digital verification and fraud analysis. Specifically, the goals are:

1. To apply Optical Character Recognition (OCR) techniques for accurate extraction of Bangla text from land-related documents such as *Khotiyan*.
2. To preprocess and enhance scanned image quality using techniques like grayscale conversion and thresholding to improve OCR accuracy.
3. To validate the extracted text for completeness, duplication, and consistency to ensure dataset integrity.
4. To build a foundation for fraud detection, enabling future classification of genuine versus manipulated or forged records.

Literature Review

Optical Character Recognition (OCR) plays a critical role in digitizing printed and scanned documents, especially administrative and legal records. Tools like Tesseract OCR have demonstrated strong performance for Latin-based scripts but encounter significant limitations when dealing with complex Indic scripts such as Bangla. These limitations arise due to the presence of compound characters, ligatures, and a wide range of glyph variations [1].

In [2], researchers explored training Tesseract OCR for Bangla script and achieved improved recognition for clean printed documents. However, its performance deteriorated significantly on degraded or noisy land record images. The study emphasized the need for domain-specific tuning.

Deep learning methods, particularly CRNN (Convolutional Recurrent Neural Networks), have emerged as powerful alternatives for text recognition. As demonstrated in [3], Bangla handwritten digit recognition using CNN-LSTM architecture outperformed traditional OCR in terms of accuracy. Yet, such approaches have not been widely applied to full Bangla text documents, especially scanned official land records.

Image preprocessing has also proven effective in improving OCR outcomes. The work in [4] used adaptive thresholding to enhance Bangla text image quality before applying OCR. Their results showed substantial accuracy gains, especially when processing old or faded documents.

Recently, EasyOCR, which integrates deep learning-based text recognition with pre-trained models for multiple scripts (including Bangla), has shown promise. While EasyOCR performs better than traditional engines on noisy and low-resolution Bangla text, it still struggles with inconsistently formatted documents like land records, which contain varied layouts, typefaces, and handwritten entries.

In summary, while prior work provides valuable foundations in OCR for Bangla text, there remains a notable gap in handling Bangla land records, necessitating a domain-adapted approach combining preprocessing, OCR tuning, and robust validation.

Methodology

This study proposes a pipeline for extracting Bangla text from scanned land record documents using Optical Character Recognition (OCR). The entire process is composed of the following stages:

A. Dataset Collection

The dataset was collected manually from a government office, where permission was granted to digitize land records by a designated officer, the Upazila Land Administrative Officer (ULAO). The images include various land record types such as Khotiyan, Porcha, and Deed documents, written in printed Bangla. A total of 100+ high-resolution images were captured and stored in .jpg format for experimentation.

B. Dataset Description

* Image Class: Printed Bangla land records (black and white / color scans).
* Data Structure: Each image is stored with a unique identifier. OCR outputs are stored in key-value format:
* {
* "image\_id": "khotiyan\_001.jpg",
* "extracted\_text": "..."
* }
* Storage Format: The outputs are stored in both .jsonl and .csv format using pandas and jsonlines libraries for further processing.
* File Size: Average image size is ~ 1MB to 3MB.

C. Image Preprocessing

Each image undergoes preprocessing using OpenCV:

* Grayscale Conversion: To simplify image complexity.
* Thresholding (Otsu’s method): Enhances text clarity by binarizing the image.
* Noise Removal (optional): Helps reduce OCR errors caused by background noise.

D. OCR Extraction using EasyOCR

We use the EasyOCR library configured with the ben (Bangla) language model. It leverages a deep learning-based detection-recognition pipeline:

* Text Detection: A CRAFT-based detector locates text bounding boxes.
* Text Recognition: CRNN-based model decodes Bangla characters.

The model is loaded using:

reader = easyocr.Reader(['ben'], gpu=False)

E. Batch OCR Processing

To handle large datasets, the OCR script was modified to:

* Iterate through a folder of land record images.
* Apply the same preprocessing and OCR pipeline to each image.
* Store results in a structured output for evaluation.

F. Output Evaluation

OCR outputs are evaluated based on:

* Text Presence: Checking if meaningful Bangla text is extracted.
* Length Threshold: Ensuring a minimum of 50 words for document validity.
* Error Logging: Empty results or corrupt images are flagged.

Results and Analysis

This section presents the findings and performance outcomes of applying Bangla OCR techniques to scanned land records. The results are analyzed based on the text extraction quality, dataset statistics, and a comparative understanding with existing research findings.

A. Dataset Performance & Findings

The OCR pipeline was executed on a dataset of 100+ scanned land record images, primarily composed of Khotiyan, Porcha, and property registration documents.

| Metric | Value |
| --- | --- |
| Total Images Processed | 100 |
| Valid Text Extractions | 91 |
| Failed / Empty Extractions | 9 |
| Minimum Word Threshold (≥ 50 words) | 72 |
| Average OCR Accuracy (manual comparison) | ~83% |

* Most common errors involved missing characters or misrecognized compound letters, particularly in degraded or noisy images.
* OCR performance was significantly better on clean, printed forms versus handwritten or faded entries.

B. Analysis of Findings

Using easyocr.Reader(['ben']), Bangla text was successfully extracted from the majority of documents with minimal configuration. The preprocessing step (grayscale + thresholding) played a critical role in improving recognition quality.

Findings from our metrics script:

* Missing Values: < 10% of documents had partial or empty results.
* Duplicate Detections: Very few title similarities observed due to varied structure across documents.
* Content Length: 28% of entries had fewer than 50 words, indicating either partial content or OCR drop-out.
* Quality Score: Overall calculated dataset quality was ~82.4%, combining content length, duplication, and completeness.

C. Comparison with Previous Research

| Study | Approach | Dataset | Reported Accuracy |
| --- | --- | --- | --- |
| [1] M. Islam et al. (2020) | Tesseract OCR on Bangla legal documents | 50+ forms | ~78% |
| [2] S. Rahman et al. (2021) | DeepOCR + CNN on printed texts | Custom dataset | ~85% |
| Our Method (EasyOCR) | EasyOCR with preprocessing | 100+ land record images | ~83% |

Difference: Unlike other studies which used segmented text blocks, our approach processes full scanned documents in one pass, making it more scalable for archival tasks.

D. Key Observations

* EasyOCR significantly reduces the complexity of pipeline setup and performs well on full documents with mixed fonts and standard Bangla typography.
* Performance drops when image resolution is low, text is handwritten, or ink bleeding occurs.
* Previous works relied heavily on Tesseract-based OCR; however, EasyOCR's deep learning backend provides better generalization across fonts and spacing variations.

References (IEEE Format)

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