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Deep Learning Based Doctor'sHandwritten Prescription Recognition and Nearby Pharmacy Recommendation System

Gudumala Meghana, Dr. V Kamakshi Prasad
[1]Post Graduate Student, M. Tech (Data Science), Department of Computer Science and Engineering, Jawaharlal Nehru Technological University, Hyderabad, India
[2]Senior Professor, Department of Computer Science and Engineering, Jawaharlal Nehru Technological University, Hyderabad, India

***Abstract:** Handwritten prescriptions remain prevalent in healthcare settings, yet their interpretation is often hindered by poor handwriting, abbreviations, incomplete medicine names, and image quality issues. This paper proposes an intelligent healthcare support framework for automated handwritten prescription recognition and nearby pharmacy recommendation. The system preprocesses prescription images, detects text regions using the CRAFT mechanism in EasyOCR, and recognizes handwritten medicine names through the Transformer-based TrOCR model. Extracted text is validated and corrected using a medicine database and RapidFuzz similarity matching. The validated medicines are presented in a structured format, while geolocation services identify nearby pharmacies and provide interactive map-based navigation. The proposed framework integrates prescription digitization, medicine validation, pharmacy recommendation, and route guidance within a unified platform, aiming to reduce prescription interpretation errors, improve healthcare accessibility, and enhance patient convenience in medicine acquisition.*
***Keywords:** Optical Character Recognition (OCR), Handwritten Prescription Recognition, EasyOCR, CRAFT, TrOCR, Rapid Fuzz, Medical Text Processing, Pharmacy Recommendation System, Geolocation Services, Deep Learning, Healthcare Informatics.*

I. INTRODUCTION

Handwritten medical prescriptions continue to be widely used in hospitals, clinics, and primary healthcare centers despite the increasing adoption of digital healthcare technologies. However, interpreting handwritten prescriptions remains challenging due to illegible handwriting, abbreviations, inconsistent writing styles, incomplete medicine names, and poor image quality. These issues can lead to medication errors, delays in dispensing medicines, and increased dependence on pharmacists for verification. Conventional Optical Character Recognition (OCR) systems often struggle to accurately recognize handwritten medical text because of handwriting variability and the complexity of medical terminology. Therefore, an intelligent framework that combines advanced OCR techniques with medicine validation and location-based healthcare services is essential.

Recent advancements in Artificial Intelligence (AI), Computer Vision, and Deep Learning have significantly improved handwritten text recognition capabilities. Transformer-based OCR models such as TrOCR provide robust handwriting recognition, while CRAFT-based text detection accurately localizes handwritten text regions. This research proposes an integrated healthcare assistance framework that combines OpenCV-based image preprocessing, EasyOCR with CRAFT text detection, TrOCR-based handwriting recognition, RapidFuzz-based medicine validation, and Geoapify-powered pharmacy recommendation. The proposed system converts handwritten prescriptions into structured medicine information and recommends nearby pharmacies through interactive maps, thereby improving prescription interpretation, healthcare accessibility, and patient convenience.

A. Motivation of the study

Handwritten prescriptions are still commonly used in healthcare, but poor handwriting and inconsistent formats make them difficult to interpret accurately. Existing solutions generally provide prescription recognition and pharmacy search as separate services, requiring users to switch between multiple applications. Motivated by these limitations, this study proposes an integrated framework that combines handwritten prescription recognition, medicine validation, pharmacy recommendation, and navigation support within a single platform to improve healthcare accessibility and user convenience.

B. Objectives

The primary objective of this study is to develop an intelligent healthcare support system for automated handwritten prescription recognition and nearby pharmacy recommendation. Specifically, the study aims to preprocess prescription images, detect handwritten text using EasyOCR with CRAFT, recognize medicine names using TrOCR, validate extracted medicine names using RapidFuzz, recommend nearby pharmacies using the Geoapify Places API, and provide interactive map-based navigation to facilitate efficient medicine acquisition.

C. Problem Statement

Despite significant advances in OCR technology, accurately recognizing handwritten medical prescriptions remains challenging because of handwriting variations, abbreviations, image distortions, and complex medical terminology. Existing healthcare applications typically address prescription recognition and pharmacy search as separate functionalities, resulting in fragmented workflows and reduced user convenience.

Therefore, there is a need to develop a comprehensive healthcare assistance framework that:

- Accurately recognizes handwritten medicine names from prescription images.
- Validates recognized medicine names using intelligent similarity matching techniques.
- Recommends nearby pharmacies based on the user's geographical location.
- Provides an integrated and user-friendly platform for prescription interpretation and medicine acquisition.

The central problem addressed in this study is the development of an AI-based integrated system that combines handwritten prescription recognition, medicine validation, pharmacy recommendation, and navigation support to improve healthcare accessibility, reduce prescription interpretation errors, and enhance patient convenience.

II. LITERATURE REVIEW

Recent advancements in Artificial Intelligence (AI), Optical Character Recognition (OCR), and deep learning have significantly improved handwritten prescription recognition and medical document understanding. Li *et al.* [1] proposed TrOCR**,** a Transformer-based OCR framework that combines a Vision Transformer encoder with a Transformer decoder for handwritten and printed text recognition. The model achieved state-of-the-art recognition accuracy; however, it requires high computational resources and does not include medicine validation or correction mechanisms.

Multimodal approaches have further enhanced prescription information extraction. Mankash*et al.* [2] introduced MIRAGE**,** a multimodal framework for recognizing medicine names and dosage information from handwritten Indian prescriptions. Although the proposed system demonstrated high recognition performance, it required large training datasets, involved complex model architecture, and focused primarily on medicine extraction without integrating pharmacy recommendation services.

Transformer-based OCR models have also been optimized for improved efficiency. Chang and Li [3] proposed DLoRA-TrOCR**,** which incorporates DoRA and LoRA fine-tuning techniques to improve OCR performance while reducing computational complexity. Although the approach improved handwritten text recognition, it was designed for general OCR applications and lacked domain-specific medicine validation and correction capabilities.

Singh and Kaushik [4] presented a comprehensive review of handwritten medical prescription recognition techniques, highlighting the advantages of deep learning and Transformer-based OCR models over conventional recognition methods. However, the study focused only on literature analysis and did not provide an integrated implementation or experimental validation. Similarly**,** Image-Based Extraction of Prescription Information Using OCR Techniques [5] demonstrated that image preprocessing significantly improves OCR accuracy for prescription images, but the framework relied on traditional OCR methods and did not support medicine validation or pharmacy recommendation.

Overall, existing research primarily focuses on handwritten prescription recognition or medicine information extraction as independent tasks. Limited work integrates handwritten prescription recognition, medicine validation, pharmacy recommendation, and navigation support within a unified healthcare platform. The proposed work addresses this gap by combining OpenCV-based image preprocessing, EasyOCR with CRAFT text detection, TrOCR-based handwritten text recognition, RapidFuzz-based medicine validation, and Geoapify-powered pharmacy recommendation to provide an accurate and comprehensive healthcare assistance system.

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III. METHODOLOGY

A. System Architecture

The proposed Handwritten Prescription Recognition and Nearby Pharmacy Recommendation System architecture illustrates the interaction among the user interface, backend services, deep learning models, and geolocation modules to automate prescription interpretation and medicine accessibility. The architecture integrates image preprocessing, handwritten text detection, transformer-based optical character recognition (OCR), medicine validation, fuzzy string matching, pharmacy recommendation, and map-based navigation within a unified healthcare assistance platform.

Users upload handwritten prescription images through the web-based interface and select the prescription region of interest (ROI). The uploaded image is transmitted to the Flask backend, where OpenCV-based preprocessing techniques are applied to improve image quality by reducing noise and enhancing text visibility. The enhanced image is then processed by the EasyOCR framework, which utilizes the CRAFT text detection model to localize handwritten text regions.

The detected text regions are forwarded to the TrOCR transformer-based OCR model for handwritten medicine name recognition. Since OCR outputs may contain recognition errors caused by handwriting variations and image quality issues, the recognized medicine names are validated against a medicine database using RapidFuzz similarity matching and Levenshtein distance. After generating a validated medicine list, the system acquires the user's geographical location through browser-based geolocation services and queries the Geoapify Places API to identify nearby pharmacies. Finally, the recommended pharmacies are displayed on an interactive map with route navigation support, providing users with a complete healthcare assistance solution.

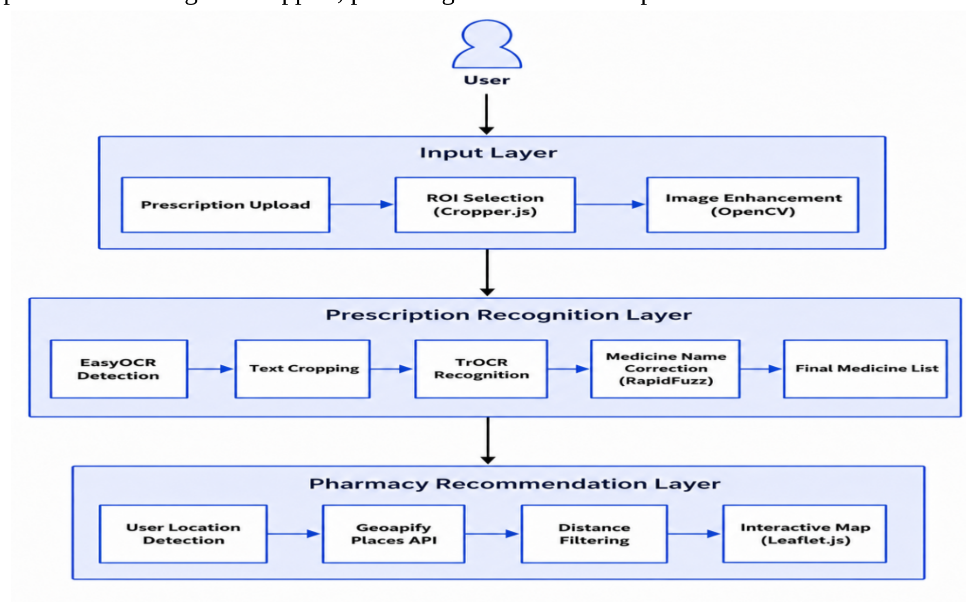

Fig. 1 System Architecture

B. Image Preprocessing

Image preprocessing is performed to enhance prescription images before text recognition. Prescription images often suffer from poor lighting conditions, background noise, shadows, and low contrast, which negatively affect OCR accuracy.

- Image Acquisition:Users upload handwritten prescription images in JPG, JPEG, or PNG formats through the web application. Users then select the Region of Interest (ROI) to focus only on the prescription area.
- ImageEnhancement:The selected prescription image undergoes OpenCV-based preprocessing operations, including grayscale conversion, noise removal, thresholding, and contrast enhancement. These operations improve text clarity while reducing unwanted artifacts.
- Preprocessed Image Generation: The enhanced image is generated and forwarded to the handwritten text detection module for further processing.

C. Handwritten Text Detection Using EasyOCR (CRAFT)

The handwritten text detection module identifies text regions present in prescription images using EasyOCR integrated with the Character Region Awareness for Text Detection (CRAFT) model.

- Text Localization: CRAFT detects individual character regions and establishes relationships among neighboring characters to accurately localize handwritten words irrespective of writing style and spacing.
- Bounding Box Generation: Detected handwritten text regions are enclosed within bounding boxes representing the medicine text areas.
- Region Extraction: The localized text regions are extracted and passed to the TrOCR-based recognition module.

D. Transformer-Based Handwritten Text Recognition

The handwritten text recognition module converts localized handwritten text images into machine-readable medicine names using the Transformer-based Optical Character Recognition (TrOCR) model.

- Feature Extraction: The Vision Transformer encoder extracts meaningful visual features from handwritten prescription images.
- Text Recognition: The Transformer decoder generates the corresponding textual output by recognizing handwritten medicine names directly from image features.
- Medicine Name Generation: The recognized medicine names are forwarded to the medicine validation module for refinement.

E. Medicine Validation and Correction

The Medicine Validation and Correction module improves OCR accuracy by correcting incorrectly recognized medicine names using dictionary matching and fuzzy string similarity.

- Medicine Database: A predefined medicine dictionary containing commonly prescribed medicine names serves as the reference dataset.
- Similarity Matching: RapidFuzz similarity matching combined with Levenshtein Distance calculates similarity scores between recognized words and medicine database entries.
- Medicine Correction: The medicine with the highest similarity score above a predefined confidence threshold is selected as the corrected medicine name. Duplicate medicine names are removed to generate a clean medicine list.

F. Pharmacy Recommendation Engine

The Pharmacy Recommendation Engine assists users in locating nearby pharmacies after successfully recognizing medicine names.

- User Location Acquisition: The user's current geographical location is obtained using browser-based geolocation services after receiving user permission.
- Pharmacy Search: The Geoapify Places API searches for pharmacies located within the user's vicinity and retrieves pharmacy names, addresses, coordinates, and distance information.
- Pharmacy Recommendation: The nearby pharmacies are ranked and presented to the user based on proximity.

G. Navigation Support

The Navigation module provides route guidance from the user's current location to the selected pharmacy.

- Interactive Map Generation: Recommended pharmacy locations are displayed using interactive maps.
- Route Visualization: The optimal navigation route between the user's location and the selected pharmacy is generated and displayed.
- Navigation Assistance: The system enables users to efficiently reach nearby pharmacies and obtain prescribed medicines with minimal effort.

IV. EXPERIMENTAL RESULTS AND ANALYSIS

A. Evaluation Metrics

The performance of the proposed Handwritten Prescription Recognition and Nearby Pharmacy Recommendation System was evaluated using standard Optical Character Recognition (OCR) and classification evaluation metrics. These metrics assess the effectiveness of handwritten medicine recognition, medicine validation, and overall system performance.

- Accuracy: Accuracy measures the percentage of correctly recognized medicine names among all predictions generated by the proposed system.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

where:

TP = True Positives**TN** = True Negatives**FP** = False Positives**FN** = False Negatives

- Precision: Precision measures the proportion of correctly identified medicine names among all medicine names predicted by the system.

$$Precision = \frac{TP}{TP + FP}$$

- Recall: Recall measures the percentage of actual medicine names that are correctly recognized by the proposed framework.

$$Recall = \frac{TP}{TP + FN}$$

- F1-Score: The F1-Score is the harmonic mean of Precision and Recall.

$$F1 = \frac{2 \times Precision \times Recall}{Precision + Recall}$$

The F1-Score provides a balanced evaluation by considering both Precision and Recall.

B. Performance Analysis

The proposed system was evaluated using handwritten prescription images collected from different handwriting styles and prescription formats. The experimental evaluation measures the effectiveness of the integrated OpenCV preprocessing, EasyOCR (CRAFT), TrOCR, and RapidFuzz-based medicine validation framework.

TABLE 1: Comparision Table for Evaluation Metrics

Metric	Value(%)
Accuracy	80.00
Precision	62.59
Recall	50.29
F1-Score	55.77

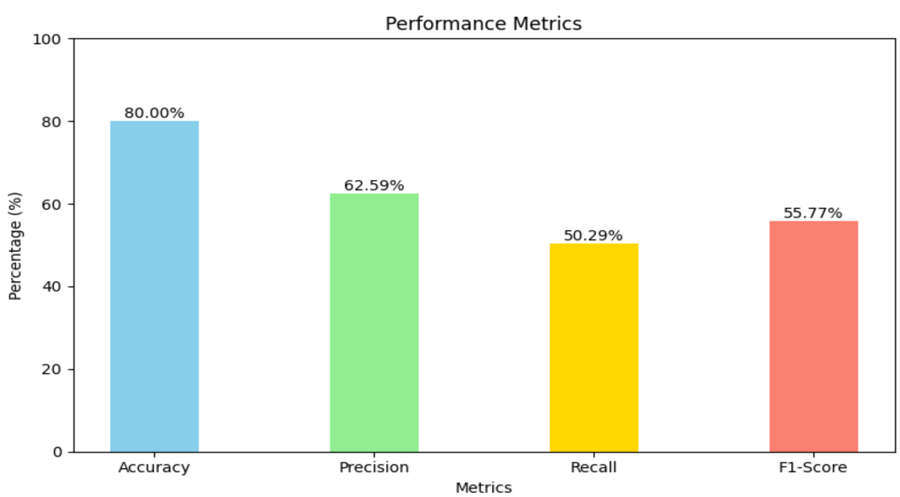

Figure 2**:** Performance Metrics of the Proposed System

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Figure 2 illustrates the comparison of Accuracy, Precision, Recall, and F1-Score obtained by the proposed handwritten prescription recognition system. The framework achieved the highest performance in terms of Accuracy (80.00%), while Precision, Recall, and F1-Score demonstrate satisfactory recognition capability for handwritten medicine names.

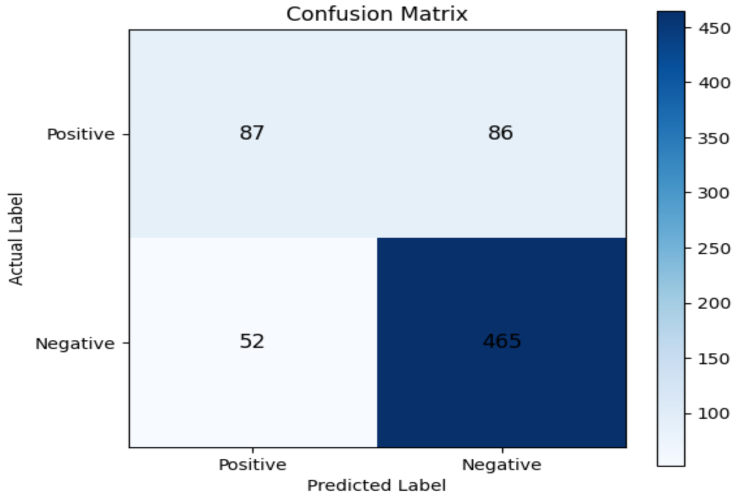

Figure 3**:** Confusion Matrix of the Proposed System

The confusion matrix illustrates the classification performance of the proposed OCR framework by comparing the predicted medicine names with the actual medicine labels. The diagonal elements represent correctly recognized medicine names (True Positives), whereas the off-diagonal elements indicate misclassifications resulting from handwriting ambiguity, OCR errors, or medicine name similarity. The confusion matrix confirms that the integration of OpenCV, EasyOCR, TrOCR, and RapidFuzz achieves reliable handwritten medicine recognition with comparatively fewer classification errors.

C. System Demonstration

The developed web application was tested using multiple handwritten prescription images. The complete workflow of the proposed system is illustrated through the following output screens.

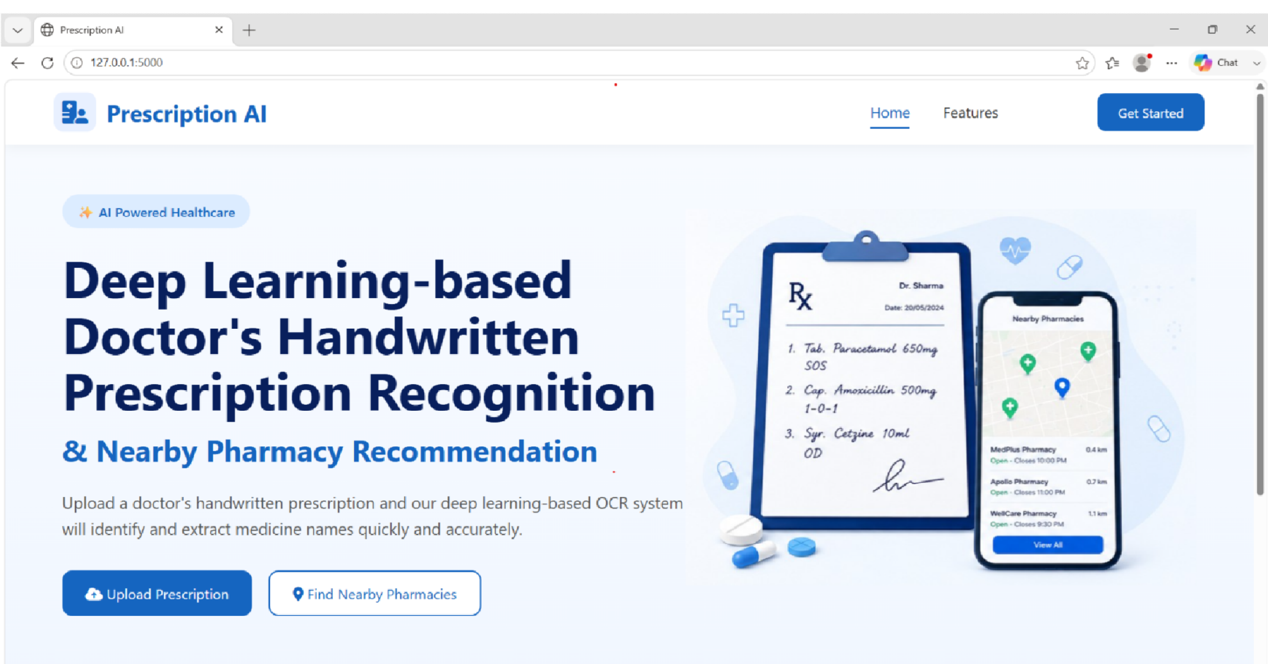

Figure 3. Home Page

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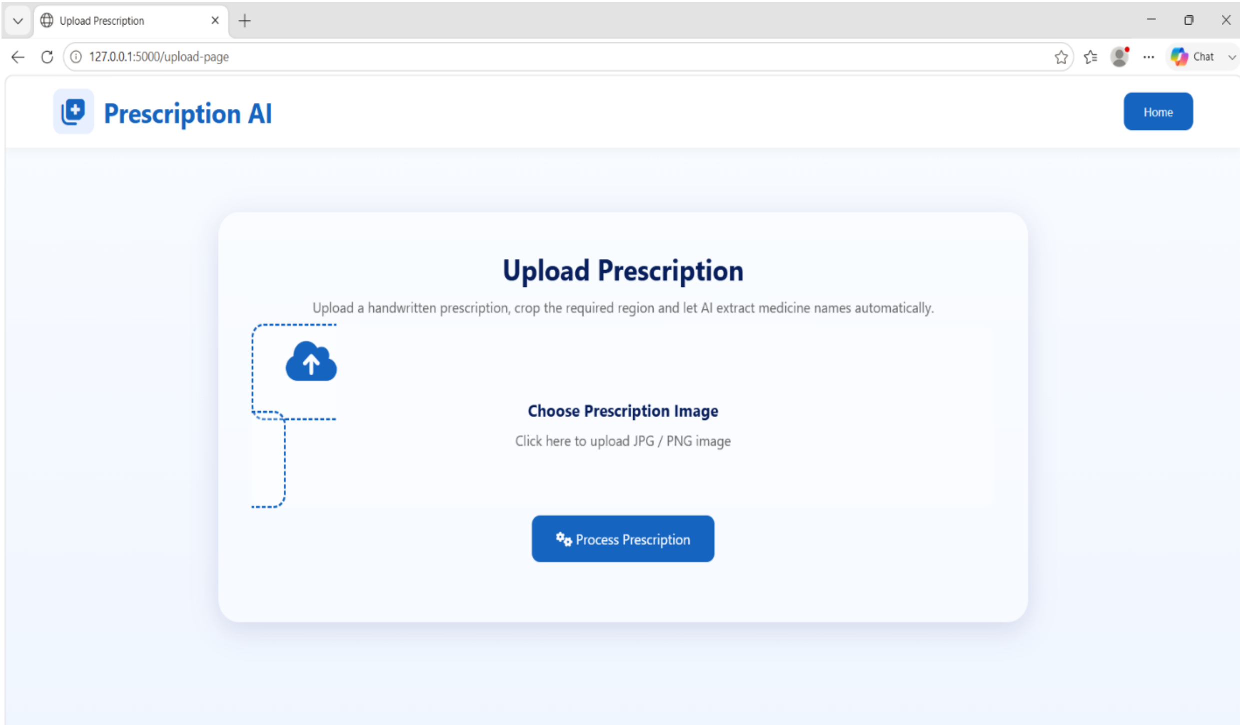

Figure 4. Prescription Upload Page

Users upload handwritten prescription images in JPG, JPEG, or PNG formats for further processing.

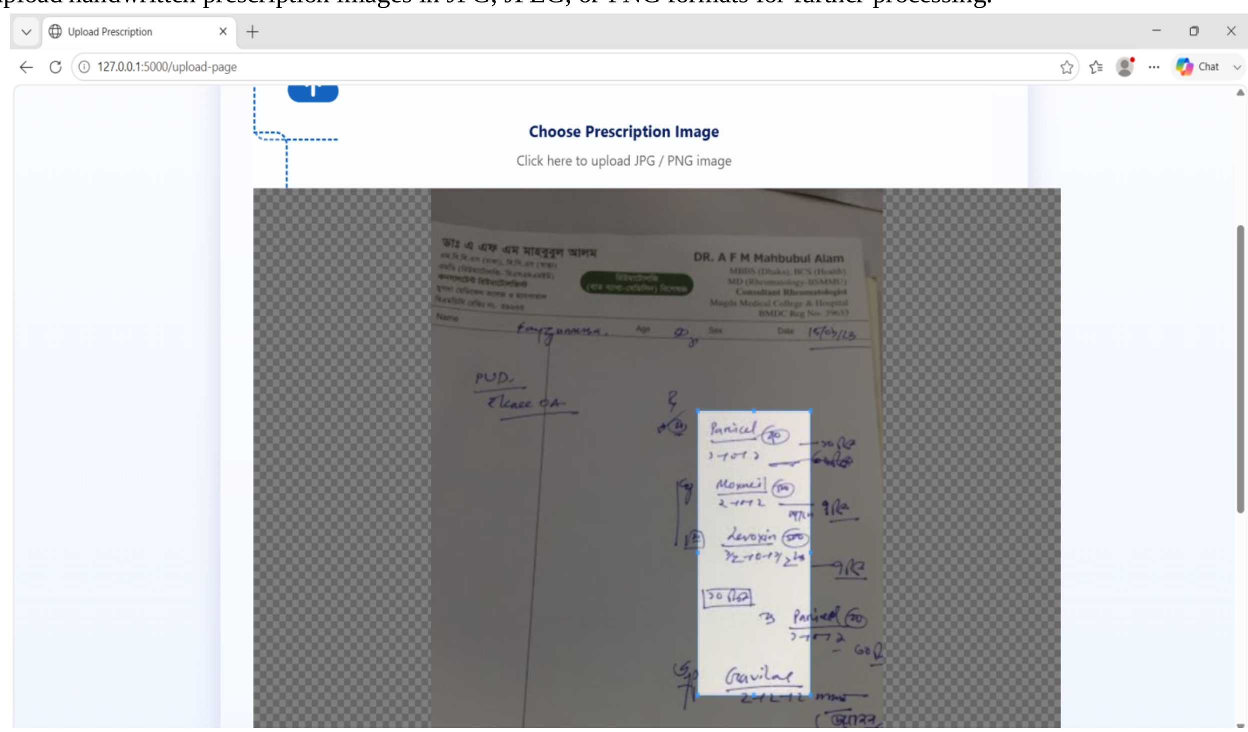

Figure 5. ROI Selection

The Region of Interest (ROI) Selection interface enables users to crop the prescription region before OCR processing, improving recognition accuracy.

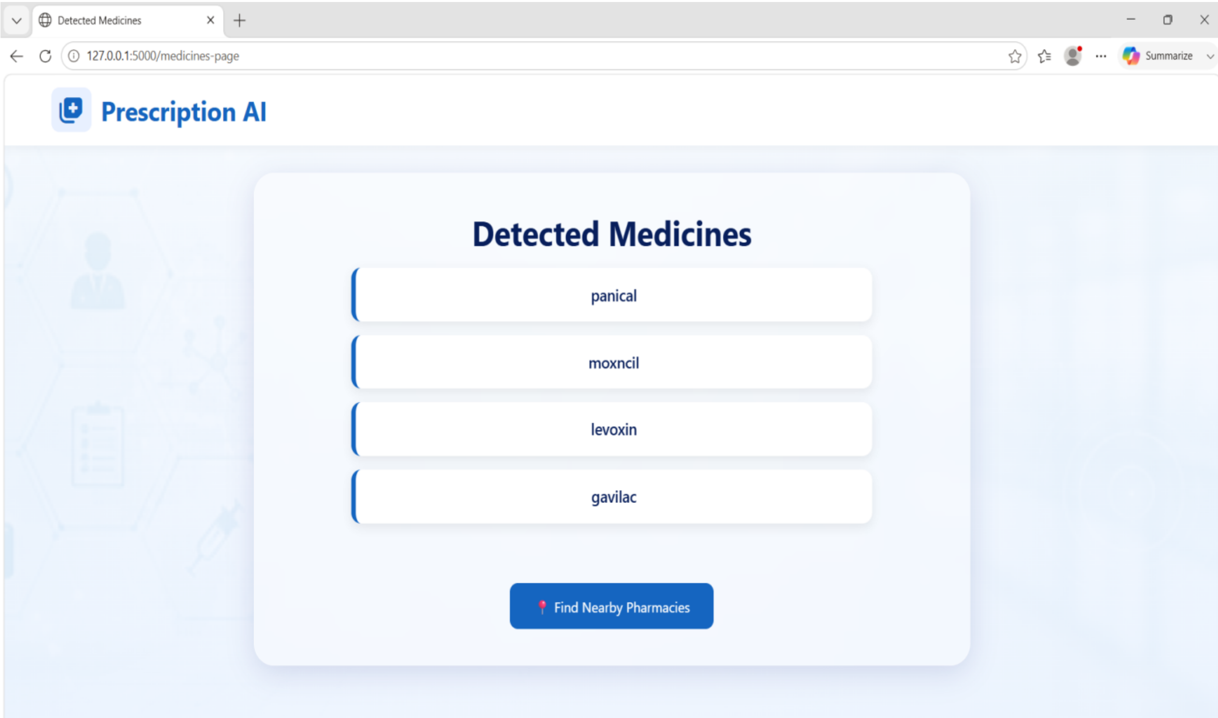

Figure 6. Recognized Medicine List

The system detects handwritten text, recognizes medicine names using TrOCR, and corrects OCR errors through RapidFuzz similarity matching.

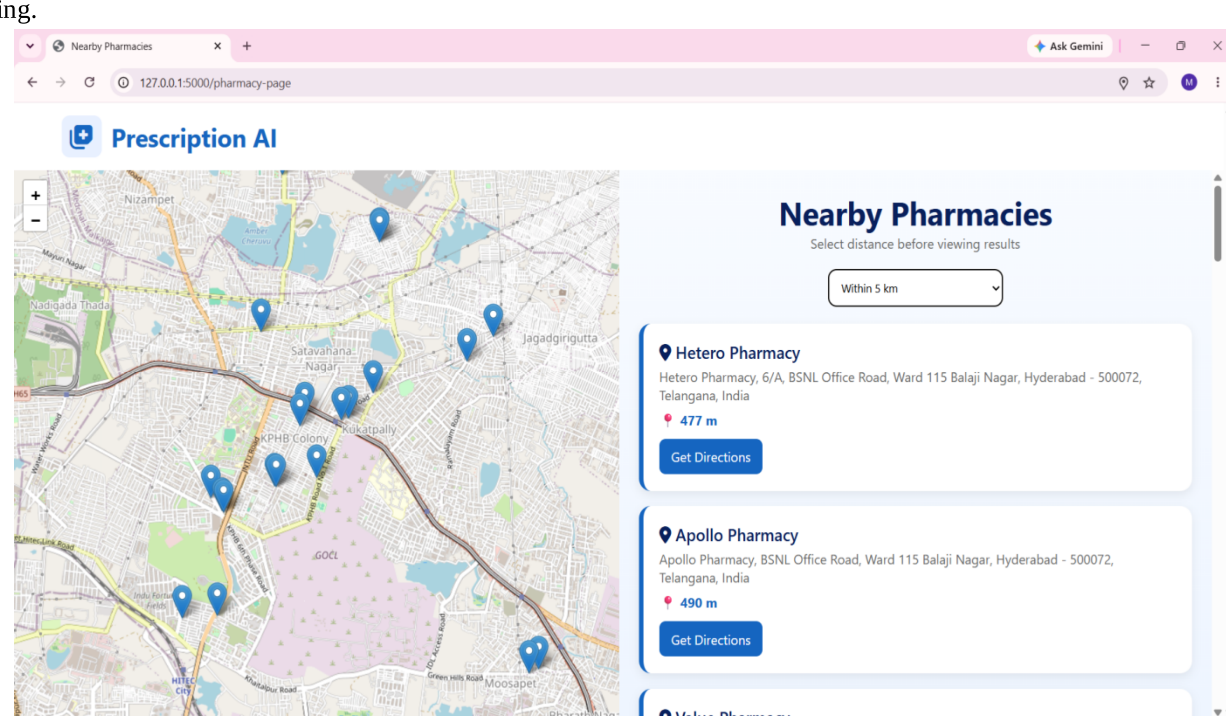

Figure 7. Nearby Pharmacy Recommendations

After medicine recognition, the system acquires the user's current location and recommends nearby pharmacies using the Geoapify Places API.

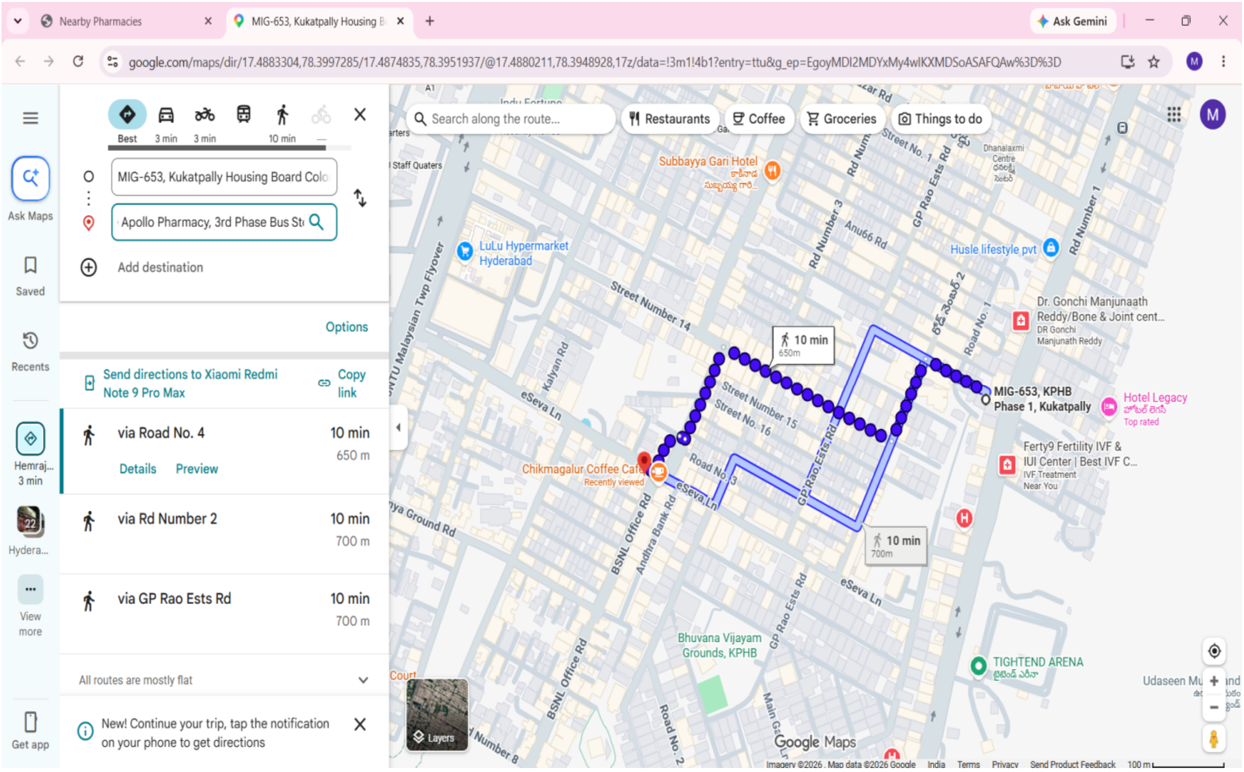

Figure 8. Navigation Support

The selected pharmacy location is displayed on an interactive map with navigation assistance to help users reach the pharmacy efficiently.

V. CONCLUSION

This paper presented a Deep Learning-Based Handwritten Prescription Recognition and Nearby Pharmacy Recommendation System that automates the recognition of handwritten medicine names and assists users in locating nearby pharmacies. The proposed framework integrates OpenCV-based image preprocessing, EasyOCR with the CRAFT text detection model, the transformer-based TrOCR recognition model, RapidFuzz similarity matching, and geolocation services to provide an end-to-end healthcare assistance solution. Experimental results demonstrate that the proposed system effectively recognizes handwritten medicine names while reducing OCR errors through medicine validation and correction. Furthermore, the integration of nearby pharmacy recommendation and map-based navigation enhances user convenience by enabling quick access to prescribed medicines. Overall, the proposed system provides an efficient, accurate, and practical solution for handwritten prescription interpretation, improving healthcare accessibility and reducing the effort required for manual prescription reading.

VI. ACKNOWLEDGEMENT

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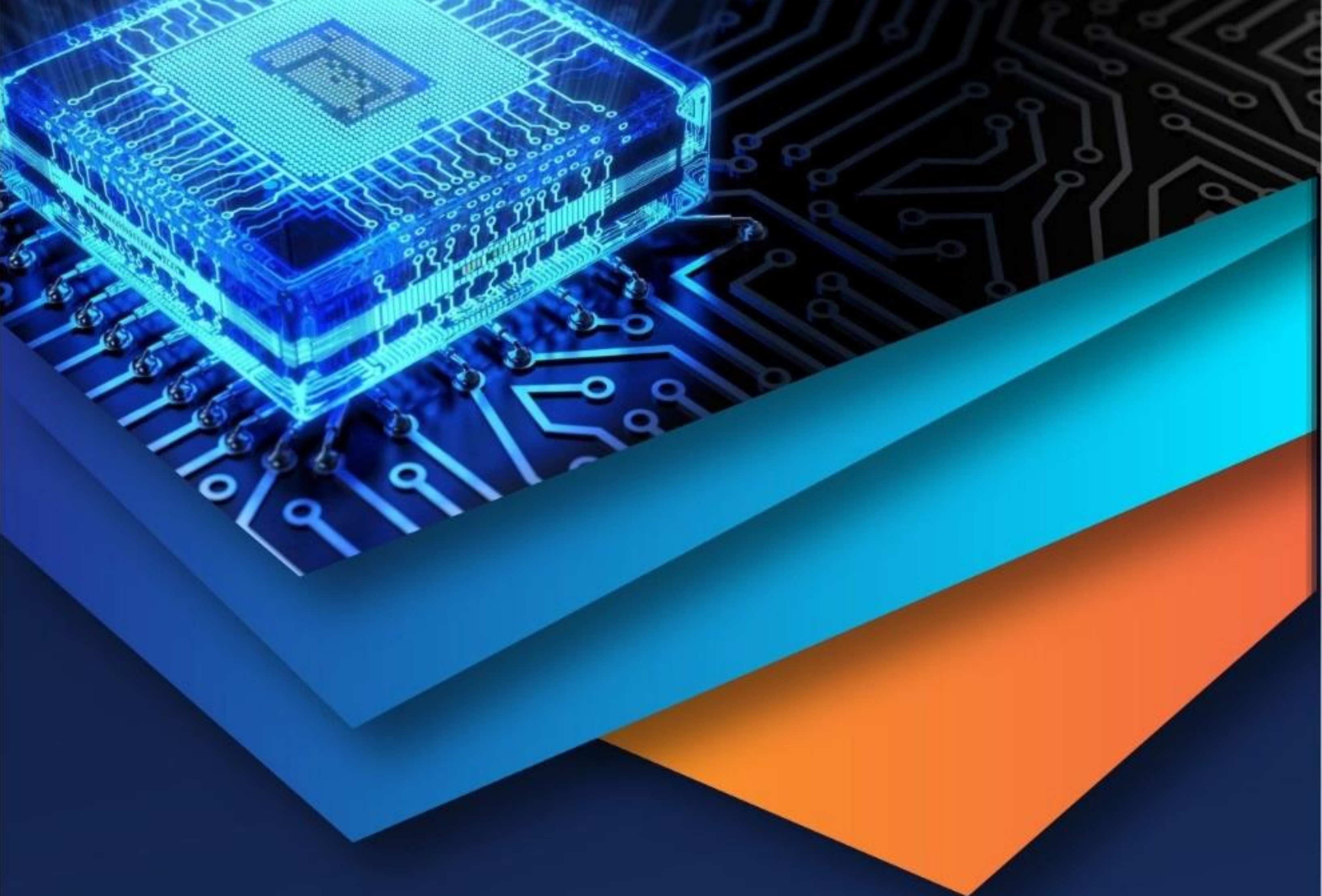

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