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# DOCTOR'S PRESCRIPTION RECOGNITION LEARNING: A SURVEY

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## ABSTRACT

Handwriting recognition, a subject of enduring interest, spans applications from signature verification to image text recognition. Particularly crucial in medical records, deciphering doctors' handwriting establishes a vital link between patients and physicians. This project introduces a deep learning system, leveraging Convolutional Neural Networks for detecting doctors' handwriting. Trained on a substantial dataset, the system incorporates preprocessing techniques, convolutional and pooling layers, and a fully connected layer for image classification. Through a supervised learning approach and evaluation on a distinct test dataset, the system aims to enhance accuracy. Beyond medical applications, potential use cases extend to finance for check processing and postal services for address recognition. The project's outcomes hold the promise of more efficient handwriting recognition systems, ultimately reducing medical errors and positively impacting patient care. The proposed system represents a significant contribution, particularly beneficial in the medical industry, showcasing its broader potential across various domains. Additionally, a mobile user interface is being developed to enhance accessibility and facilitate seamless integration into various professional workflows.

**Keywords:** Convolutional Neural Networks, Supervised Learning, Deep Learning ,Handwriting Recognition.

## I. INTRODUCTION

In the realm of healthcare, the often illegible handwriting of busy doctors poses a significant challenge, particularly in the prescription-writing process. The prioritization of swift diagnoses over the clarity of prescriptions can lead to serious consequences, with patients and pharmacists struggling to decipher the handwritten instructions. To mitigate this issue, innovative solutions like the Deep Convolutional Recurrent Neural Network (RNN) approach have been proposed. This technology aims to recognize and interpret alphabets and numerals in English handwriting, significantly enhancing prescription legibility. Moreover, considering the linguistic diversity in a country like India, our paper advocates for the incorporation of regional language support in these applications, fostering better communication between pharmacists and patients.

Our paper delves into the effectiveness of various data augmentation techniques to improve the accuracy of the proposed system. By expanding the dataset through these augmentation methods, we aim to demonstrate a substantial increase in recognition accuracy compared to models without such enhancements. Leveraging Optical Character Recognition (OCR) technology, our approach involves training neural networks to predict text within digital images of handwritten prescriptions. The culmination of this research effort manifests in the development of a mobile application, featuring separate dashboards for doctors and pharmacists, thus optimizing the user interface. This application integrates seamlessly into the healthcare workflow, offering a technological solution to the longstanding challenge of deciphering handwritten prescriptions, ultimately enhancing patient safety and healthcare efficiency

## II. LITERATURE SURVEY

- The study effectively deployed a hybrid model in web and mobile applications, showcasing superior identification of prescriptions. Out of 540 images, 389 were accurately recognized, resulting in a 72% accuracy on mobile testing. A second validation, comprising 48 samples, demonstrated a 35% accuracy for the mobile application's model implementation. The successful amalgamation of CNN and RNN in a Doctors' Cursive Handwriting Recognition System achieved its intended purpose, recognizing script prescriptions and converting them to normal text. The mobile and web application implementation served as a conclusive proof of concept for the proposed hybrid.[1]

- In this study, we introduce HTG-GAN, an innovative generative model for synthesizing handwritten glyphs. We redefine the structural relationship between sequence characters as a style representation disentangling task, separating style from content. This approach allows us to generate new style text images with specific content, as validated by extensive experiments. However, adapting the model to languages with a large number of characters, like Chinese or Japanese, requires a novel encoding strategy considering radical and stroke information. Additionally, integrating handwritten glyph synthesis and texture transfer in an end-to-end manner remains an intriguing avenue for future exploration.[2]
- This paper introduces a novel post-correction approach for OCR-generated output, utilizing the RoBERTa language model on UK NHS medical reports and MiBio dataset. Results exhibit reduced average WER and CER, suggesting applicability in domain-specific applications with similar document characteristics. The method is a crucial first phase in automating medical information extraction from NHS patient reports, with future enhancements planned, including adding medical terminologies to the spell-checking vocabulary, improving image quality, and training the model with domain-specific datasets for further error rate reduction.[3]
- This research aims to real-time recognition and digitization of doctors' handwriting through three key contributions: (a) developing a medical term corpus, (b) introducing a novel data augmentation technique (RSS), and (c) employing a machine learning approach for final recognition. The Bidirectional LSTM model achieved a 93.0% average accuracy, outperforming non-augmented results by 19.6%. While proposing a smartpen system for doctors, there is room for accuracy improvement by exploring alternative computational intelligence algorithms like Monarch Butterfly Optimization, Earthworm Optimization Algorithm, Elephant Herding Optimization, Moth Search Algorithm, and Harris Hawk Optimization. Additional data collection and capturing individual handwriting habits are suggested for further accuracy enhancement.[4]
- For optimal results, we ensured accurate model data and trained it with 50 epochs to enhance prediction proficiency. The dataset was split into 90% for training and 10% for testing, minimizing the CTC loss function for optimal word prediction. Additionally, we revised predicted text using medical data, offering concise pill summaries. Testing the model at a local pharmacy revealed its ability to distinguish diverse handwritten notes from physicians, highlighting both faults and benefits. Ultimately, our system accurately detects and delivers a doctor's prescriptions to consumers in their preferred language.[5].
- The study addresses illegible prescriptions by proposing a mobile app using Convolutional Neural Network (CNN) and Optical Character Recognition (OCR). It recognizes handwritten medicine names, enhancing readability and aiding pharmacists and patients. Real-case testing achieved 70% accuracy, indicating potential in mitigating distortion and minimizing doubts in medication names for practical implementation in healthcare.[6]
- Addressing the longstanding challenge of handwriting recognition in computer vision, particularly crucial in the medical field for maintaining a clear link between patients and physicians,this paper proposes a deep learning-based system for doctors' handwriting recognition. Leveraging Convolutional Neural Networks (CNNs) and a substantial dataset, the system aims to enhance accuracy and efficiency. This project's impact extends to healthcare applications such as electronic medical records, telemedicine, and mobile platforms, promising advancements that can significantly improve patient safety, care quality, and the overall effectiveness of medical simulations. Integration with electronic health records further facilitates streamlined storage, retrieval, and analysis of patient information, marking a substantial step towards addressing the persistent issue of medical errors stemming from illegible handwriting.[7]
- The healthcare industry's focus on patient happiness and reduced waiting times prompted the development of a machine-learning-based framework. Illegible prescriptions were addressed using a mobile application employing various prediction methods, providing clarity for pharmacists and patients, with results analyzed and compared for effectiveness borders.[8]

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**The below list outlines survey of papers related to the topic in brief with possible gaps/limitations within the proposed system.**

| Title | Author | Year of publication | Objectives | Gaps Identified | Methodology | Results | Conclusion |
|---|---|---|---|---|---|---|---|
| Doctor's Cursive Handwriting Recognition System Using Deep Learning | L. J. Fajardo | 2019 | The objectives of the study were to develop a hybrid model for web and mobile applications that could effectively identify prescriptions written in doctors' cursive handwriting and convert them into normal text. | Low accuracy | The study utilized a hybrid model that combined Convolutional Neural Network (CNN) and Recurrent Neural Network (RNN) algorithms. The model was implemented in both web and mobile applications. The researchers collected a dataset of 540 prescription images and tested the model's accuracy in recognizing and converting them. Additionally, a second validation was conducted using 48 samples to evaluate the accuracy of the mobile application's | Out of the 540 prescription images tested, the hybrid model accurately recognized 389 of them, resulting in a 72% accuracy rate during mobile testing. The second validation, using 48 samples, showed a 35% accuracy rate for the mobile application's model implementation. | The study successfully achieved its intended purpose of developing a Doctors' Cursive Handwriting Recognition System using the hybrid model. The CNN and RNN algorithms effectively recognized script prescriptions and converted them into normal text. The implementation of the hybrid model in both the mobile and web applications served as a conclusive proof of concept for the proposed approach. |

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| Handwritten Text Generation via Disentangled Representations | X. Liu, G. Meng, S. Xiang and C. Pan | 2021 | The model aims to perform data augmentation to boost handwritten text recognition (HTR) and achieves state of the art performance in handwritten text generation | Complexity and computed cost | Decoupling mechanism | Can generate handwritten text images with specified contents and various styles to perform data augmentation | It can generate into an understandable form(in Chinese) |
| An OCR Post-Correction Approach Using Deep Learning for Processing Medical Reports | [1] Srinidhi Karthikeyan ,Alba G. Seco de Herrera , Faiyaz Doctor , Senior Member, IEEE, and Asim Mirza. | 2022 | Addressing OCR challenges, a self-supervised pre training technique, RoBERTa is proposed significantly reducing word error rates in processing real medical documents. | Dependency on specific datasets, potential challenges with uncommon medical terms, and ongoing adaptation needs for diverse medical contexts. | OCR post processing includes space removal, entity filtering, and identification /masking of incorrect words for improving accuracy. | The project enhances a document processing, pipeline for automating NHS patient report information retrieval. It categorizes medical documents, identifies key modifications, and recommends updates for instant inclusion | The proposed method uses RoBERTa language model for post processing of the OCR output text. This method is tested on the UK NHS medical reports dataset. |

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| An online cursive handwritten medical words recognition system for busy doctors in developing countries for ensuring efficient healthcare service delivery | ShairaTabassum1*, NurenAbedin1 , Md Mahmudur Rahman2 , Md Moshiur Rahman3 , MostafaTaufqAhmed4 , Rafqul Islam2,5 & AshirAhmed1,2. | 2022 | Enhance healthcare efficiency with machine learning for accurate digital recognition of handwritten prescriptions in developing countries. Develop a smartpen solution for real time digitization, reducing medical errors and costs. | Single Language Conversion. | Data augmentation using RSS | The proposed handwritten recognition technology can be installed in a smartpen for busy doctors which will recognize the writings and digitize them in real time. | For busy doctors, the suggested handwritten recognition technology can be integrated into a smartpen, which will recognize handwriting and digitize it instantly. The smartpen is anticipated to lower medical blunders, decrease medical expenses, and guarantee a healthy lifestyle in developing nations. |
| Doctor's Handwritten Prescription Recognition System In Multi-Language Using Deep Learning | Pavithiran G1 , Sharan Padmanabhan2 , Nuvvuru Divya3 , Aswathy V 4 , Irene Jerusha P5 , Chandar B6 | 2022 | The system using several networks CNN, RNN, LSTM to recognize and translate handwritten prescriptions to various | The proposed system cannot be applied for all the systems | Data collection, Data Processing, Model Building, Prediction readable prescription. | The model went around 50 epochs to get trained and furthermore predicted text was compared with | Detection of handwritten notes and conversion to language of your choice |

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| Medical Prescription Recognition using Machine Learning | Esraa Hassan, Habiba Tarek, Mai Hazem, Shaza Bahnacy, Lobna Shaheen, Walaa H. Elashmwai. | 2021 | Proposes a mobile app using CNN for recognising doctor's handwriting on prescriptions. | Readable digital text with 70 % accuracy | Used CNN for image reading and OCR for character recognition. | The proposed system utilizing CNN and OCR demonstrated promising outcomes in recognizing handwritten medicine name. | In addressing the challenge of deciphering doctor's illegible prescriptions, the proposed system, leveraging machine learning with Convolutional Neural Network(CNN) and Optical Character Recognition(OCR) presents a viable solution. |
| Natural Language Processing and Computer Vision in Healthcare :Doctor's Handwriting Recognition | Mehee Porwal Mitesh Khemani. | 2023 | Create a CNN based system for precise detection of doctors handwriting improving medical record accuracy. Train the system using supervised learning on a diversed data set. Extended applications to finance and Postal | System performance is heavily tied to data quality and challenges include Limited medical expertise capture and dependence on technology .Interp-retability issues and ethical considerations such as | Integrate AI into Healthcare systems and train algorithms for accurate diagnosis validate algorithms for Real world scenarios and integrate into clinical workflows provides staff training and ensure continuous improvement for optical | Improved handwriting recognition and precise Healthcare diagnosis via machine learning enhance efficiency and cut costs | AI boosts doctors handwriting recognition aiding accurate medical documentation. Algorithms transcribe notes reducing errors for prompt diagnosis leading to improved Patient Safety |

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| | | | Services enhancing efficiency in handwriting recognition systems | privacy and bias also arise | patient care | | collaboration and cost savings |
| Comparison Of Various Machine Learning Algorithms For Recognizing Text On The Medical Prescriptions | Sandhya P1, Rama Prabha K.P2, Jayanthi.R3, V. Sujatha4, Asha N5, M B Benjula anbu malar6 | 2022 | Enhance patient satisfaction by reducing waiting times in healthcare through a machine learning based framework. Develop a mobile application to read and interpret handwritten prescriptions, providing clear medication information for both pharmacists and patients. | Despite using a diverse data set potential gaps may arise in limited doctor and pharmacist representation impacting the models generalization | The proposed methodology involves scanning medical prescriptions using a mobile devices camera followed by preprocessing steps like picture removal, black and white conversion , noise removal and image scaling | The implemented CNN successfully categorised prescription drugs and extracted features | The Python implemented CNN trained on a diverse data set of prescriptions successfully categorised and extracted features |

## III. EXISTING SOLUTION

Various studies showcase innovative solutions across diverse domains. One study achieves 72% accuracy in prescription identification using a hybrid model for web and mobile applications. HTG- GAN proves effective in synthesizing handwritten glyphs, validated through extensive experiments. A post-correction approach employs RoBERTa for OCR- generated output, leading to reduced error rates. Real-time recognition of doctors' handwriting utilizes a Bidirectional LSTM model with a remarkable 93.0% average accuracy. Additionally, a proposed smartpen system aims to enhance accuracy through alternative computational intelligence algorithms and additional data collection.

Addressing the persistent challenge of handwriting recognition, particularly crucial in the medical field, we propose a deep learning-based system for doctors' handwriting recognition. Utilizing Convolutional Neural Networks (CNNs) and a substantial dataset, the system aims to improve accuracy and efficiency. Impacting healthcare applications such as electronic medical records, telemedicine, and mobile platforms, this project promises advancements that enhance patient safety, care quality, and the effectiveness of medical simulations. Integration with electronic health records streamlines storage, retrieval, and analysis, addressing

the issue of medical errors from illegible handwriting. The varied approaches, including smart pens, highlight the diverse strategies employed to revolutionize handwriting recognition interfaces.

## IV. PROPOSED SOLUTION

To address the persistent challenge of accurately predicting doctors' prescriptions, our proposed solution employs innovative techniques. We tackle the issue by expanding the dataset through the application of various data augmentation methods, such as RSSI, resulting in a substantial increase in accuracy. Leveraging datasets from Kaggle, we ensure effective training across diverse prescription samples using a hybrid model combining Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). Implementing Pseudencoding enhances duplicate character recognition, contributing to the system's overall precision. Furthermore, to enhance user accessibility, we are developing a user interface integrated with a mobile application. This interface streamlines the usage of our prescription prediction system, making it more convenient and user-friendly. By combining advanced data augmentation, hybrid models, and user- centric design, our proposed solution aims to revolutionize the accuracy and usability of predicting doctors' prescriptions, offering a comprehensive and effective approach to this recurring issue in healthcare.

## V. CONCLUSION

The Doctor's Prescription Recognition Project demonstrates the feasibility and effectiveness of automating the digitization process for handwritten medical prescriptions. By leveraging OCR technology and deep learning models, the project offers a scalable solution to improve the efficiency of healthcare professionals in managing patient records. Future enhancements may include integration with Electronic Health Record (EHR) systems and support for multilingual prescriptions to cater to diverse healthcare settings. Overall, the project contributes to advancing digitization efforts in the healthcare industry, enhancing patient care, and streamlining administrative processes.

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