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SMART AI-BASED SYSTEM FOR TEXT EXTRACTION

***Dhandapani P., Mrs. T. Hashni**

Dr. N.G.P. Arts and Science College, Coimbatore, Tamil Nadu, India.

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***Corresponding Author: Dhandapani P.**
Dr. N.G.P. Arts and Science College, Coimbatore, Tamil Nadu, India.
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ABSTRACT

Handwritten text recognition plays a crucial role in digitizing physical documents. This paper presents a deep learning-based system that converts handwritten English characters into digital text using Convolutional Neural Networks (CNN). The system integrates preprocessing techniques such as grayscale conversion, resizing, and normalization to enhance image quality. A CNN model is trained on a diverse dataset containing multiple handwriting styles, enabling the system to generalize effectively. Experimental evaluation demonstrates that the model achieves high accuracy and reliability in recognizing handwritten characters and converting them into machine-readable text.

KEYWORDS: Handwritten Recognition, CNN, Deep Learning, OCR, Image Processing.

1. INTRODUCTION

In many sectors such as education, healthcare, banking, and administration, handwritten documents remain widely used. However, managing and storing these documents manually is inefficient and prone to errors. Digitizing handwritten content is essential for improving accessibility, storage, and processing of information.

Traditional methods for converting handwritten text into digital format require human effort, which is time-consuming and often inaccurate. Automated systems based on artificial intelligence have emerged as an effective solution to this problem. These systems can process images and convert handwritten text into digital form with minimal human intervention.

Deep learning techniques have revolutionized the field of image processing and pattern recognition. Among these techniques, Convolutional Neural Networks (CNNs) have shown exceptional performance in recognizing patterns in images. CNN models automatically extract features from input images, eliminating the need for manual feature engineering.

This research focuses on developing an intelligent system that utilizes CNN to recognize handwritten English alphabets and convert them into digital text. The system aims to provide high accuracy, robustness, and efficiency in real-world applications.

2. LITERATURE REVIEW

Earlier approaches to handwritten text recognition relied heavily on traditional machine learning techniques. These methods required manual feature extraction, where features such as edges, shapes, and textures were designed by experts. Common techniques included Histogram of Oriented Gradients (HOG), zoning methods, and pixel-based features.

These handcrafted features were then used with classifiers such as Support Vector Machines (SVM), k-Nearest Neighbors (KNN), and Artificial Neural Networks (ANN). Although these methods produced acceptable results, they were limited in their ability to handle variations in handwriting styles, noise, and distortions.

The introduction of deep learning has significantly improved the performance of handwritten recognition systems. CNN architectures are capable of learning hierarchical features directly from raw image data. The initial layers capture low-level features such as edges, while deeper layers capture complex patterns such as character shapes.

Recent research indicates that CNN-based models outperform traditional approaches in terms of accuracy and scalability. These models have been successfully applied to various recognition tasks, including digit recognition, alphabet classification, and multi-language handwriting recognition. As a result, CNN has become the preferred choice for modern handwritten text recognition systems.

3. PROPOSED METHODOLOGY

The proposed system follows a structured pipeline consisting of dataset collection, preprocessing, feature extraction, and classification. The dataset contains handwritten alphabet images along with corresponding labels.

During preprocessing, images are converted into grayscale to reduce computational complexity. They are then resized to a uniform dimension and normalized to ensure consistency in input data. These steps improve the quality of the input and enhance model performance.

The processed images are fed into a CNN model, which automatically extracts relevant features. The model uses convolution layers to detect patterns, pooling layers to reduce

dimensionality, and fully connected layers for classification. This architecture enables accurate recognition of handwritten characters.

4. Algorithm Implementation

Step 1: Dataset Collection - Collect handwritten character images and corresponding labels.
Step 2: Preprocessing - Convert images to grayscale, resize to fixed dimensions, and normalize pixel values.
Step 3: Dataset Splitting - Divide data into training and testing sets (80% and 20%).
Step 4: Model Construction - Build CNN architecture with convolution, pooling, and dense layers.
Step 5: Training - Train the model using backpropagation and optimize parameters.
Step 6: Evaluation - Test the model using unseen data and calculate accuracy metrics.
Step 7: Prediction - Input new handwritten images and predict corresponding characters.
Step 8: Output Generation - Convert predictions into digital text format.
The CNN model uses activation functions such as ReLU and Softmax for classification. Optimization techniques like gradient descent are used to minimize error during training.

5. RESULTS AND DISCUSSION

The proposed system was evaluated using a dataset of handwritten alphabets. The preprocessing techniques improved the clarity and consistency of input images, leading to better performance.
The CNN model achieved the following performance metrics:
Accuracy: 95%
Precision: 94%
Recall: 93%
F1 Score: 93.5%
The results indicate that the model performs effectively across different handwriting styles. The system demonstrates strong generalization capability and robustness.

6. CONCLUSION

This research presents an intelligent deep learning-based system for handwritten text extraction. The use of CNN enables accurate recognition of handwritten characters and efficient conversion into digital format.
The system achieves high accuracy and can be applied in various real-world applications such as document digitization, form processing, and archival systems.

Future work may focus on extending the system to recognize full words and sentences, as well as supporting multiple languages. Integration with mobile and web applications can further enhance usability.

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