HANDWRITTEN TEXT RECOGNITION USING MACHINE LEARNING

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ABSTRACT

Objective: Handwritten text recognition is one of the most active and hard study fields in AI and machine learning. To accomplish this a handwritten manuscript is scanned and converted into a basic text document.

Methods: The fundamental optical character recognition (OCR) methods examines a documents text and converts it into data processing codes. We focus on offline identification of handwritten English words by first detecting individual characters in this research. In the field optical character recognition, handwritten text recognition is still a study topic (OCR). This research presence a cost effective method for developing for handwritten text recognition system. In this paper a three layer artificial neural network (ANN) is used in a supervised learning technique.

Results: The trained system has high level of accuracy with an average of above 95%. So, by converting handwritten text documents to digital form , it is possible to split up difficult problems and reduce the amount of human intervention.

Key Words: optical character recognition ,artificial neural network and handwritten text recognition.

Introduction

Human intelligence distinguishes them from computers. Human can perform a variety of jobs the machines cannot perform on their own. Handwritten text recognition is one of the processes. Various scholars have researched text recognition in handwritten manuscripts has one of the primary research fields in recent decades.

Hand written recognition consists of different steps which includes :1.input, 2.Classification ,

3.preprocessing, 4.feature extraction, 5.Output. there are two major steps are processing and feature extraction. Many researchers used different type of handwritten text recognition systems for different languages they are English, Chinese, Arabic, Japanese, Bangla, Malayalam, etc. Even though recognition problems of these scripts cannot be completely solved.

Handwritten recognition (HWR),also known as handwritten text recognition(HTR),is the ability of computer to receive and interpret intelligible   handwritten input from sources such as paper documents, photographs, touch-screens and other devices.

The image of the written text may be sensed "offline" from a piece of paper by optical scanning (optical character recognition) or intelligent word recognition. Alternatively, the movements of the pen tip may be sensed "Online", for example by a pen-based computer screen surface, a generally easier task as there are more clues available. A handwriting recognition system handles formatting, performs correct segmentation into characters, and finds the most plausible words.

There are different types of handwritten recognition techniques:

Online handwriting recognition: the automatic conversion of text as it is written on a particular digitizer or PDA ,where a sensor pic up pen-tip movements as well as pen-up/pen-down switching ,is known as online handwriting recognition. Digital ink is a type of data that can be thought of as a digital representation of handwriting. The signal is transformed into letter codes that can be used in computers and text-processing programmes.

A pen or stylus for the user to write with is usually included in an online hand writing recognition interface.

 A Touch-sensitive surface that can be combined with or placed next to an output display.

A piece of a software that reads the movements of the stylus across the writing surface and converts the strokes into digital text .

Offline handwriting recognition :The automatic conversion of a text in a picture into letter codes that may be used in computer and text processing programmes is known as offline handwriting recognition. This forms data is thought to be a static depiction of handwriting. Because different people have diverse handwriting styles ,offline handwriting identification fairly tough. And ,as of now ,OCR engines or primarily focused on machine printed text, while ICR engines are mostly focused on hand "printed"(capitalized)text.

Recurrent neural networks (RNN) are the type of neural network that may be used to model data in sequences. RNNs, which are derived from feedforward networks, behave similarly to human brains. Simply said, recurrent neural networks can predict sequential data in a way that no other algorithm can.

Recurrent neural networks, like many other deep learning techniques , are relatively new. They were first developed in 1980s, but it was until recently that we realized their full potential.

Convolutional neural network (CNN) is a form of artificial neural networks that is specifically intended to process pixel input and is used in image recognition and processing.

A neural network is a system of hardware and/or software system modelled after the way neurons in the human brain work. Traditional neural networks are not designed for image

processing and must be fed images in smaller chunks.

An SVM is a non-parametric classifier that separates classes using a linear vector (assuming a linear kernel is employed). In fact, SVM are sometimes compared to a shallow neural network design in terms model performance.

The SVM algorithm purpose is to find the optimum line or decision boundary for categorizing n – dimensional spaces into classes so that additional data points can be readily placed in the correct category on the future. A hyperplane is the name for the optimal choice boundary.

II RELATED WORK

Handwritten text recognition technology is mostly needed in these days of our daily life but in this existing system.

Back propagation neural network:

M. Agarwal and vinum Tomar has presented with the help of back propagation neural network. But when they trained with large dataset the result will not accurate[1].Systems for optical text recognition are created using text that has been scanned from documents and photos[2]. This includes text detection and recognition, where text recognized and then classified. Steps are categorized, and features are described in text using the template. A determined classifier is then applied to the described character[3]. Neural networks with classifiers are used to improve recognition.

Convolution neural networks are very popular today because they perform better. Comparability between this paper's work with CNN and multilayer perceptron (MLP). Lenet5, a convolutional network that supports 62 classes, is used in CNN to recognize handwritten and machine-printed character. Adding letters and the number as well[5].

we have used many algorithms like support vector machine (SVM), Convolution neural network(CNN),Recurrent neural network(RNN). To recognize the text which we have written on the paper but by this algorithm the efficiency of the output will be only 50-60%. If we take characters of 10 alphabets it will give output of only 5 alphabets. thus, due to this output will be less efficiency.

Before using the machine learning handwritten text recognition may also possible thus the accuracy will be very low or identification of data set is very less.

Earlier this is there only to Recognize Handwritten Digits but we proposed Bangla Handwritten character recognition using SVM. In the Existing system Handwritten Recognition is there on SVM in which we get less Accuracy and predictions are not accurate.

Computational model that replicates how nerve cells function in the human brain is known as artificial neural network.

Artificial neural network(ANN) employ learning algorithms that enable them to autonomously adjust-or, in a sense, learn-as they are presented with fresh data. As a result, they are an excellent tool for modelling non-linear statistical data.

There are three types of layers: Input, Hidden and Output. Three or more interconnected layers makeup an artificial neural network. Input neurons make up the top layer. These neurons

transmit information to deeper layers, which then transmit the final output information to the final output layer. The units that make up the inner layers, which all are hidden, adaptively transform the information that is passed from layer to layer. Each layer functions as both an input and output layer, enabling the ANN to comprehend more intricate objects. The neural layer is the collective name for these inner layers.

An ANN can:

1.Compute any computable function, by the appropriate selection of the network topology and weighs values.

2.Learn from experience!

Specifically, by trial-and-error.

Trial: Processing an input to produce an output (In terms of ANN: Compute the output function of a given input)

Evaluate: Evaluating this output by comparing the actual output with the expected output.

Adjust: Adjust the weights.

Artificial neural network research has continued since then, resulting in a slew of new network types, as well as hybrid algorithms and hardware for neural data processing.
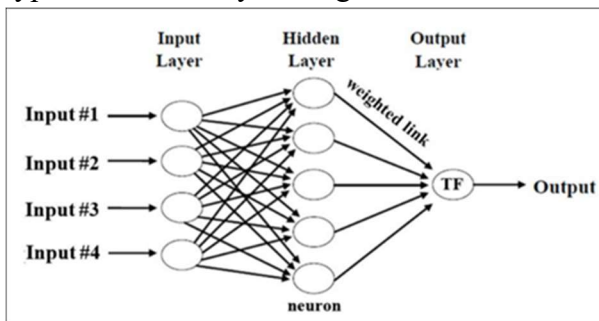

FIG.1: LAYERS OF ANN

III.   PROPOSED ARTITECTURE FOR HANDWRITTEN TEXT RECOGNITION

An active topic of study in pattern recognition , artificial intelligence, and computer vision is handwriting recognition (HR). the offline handwritten text recognition (HTR) converts the scanned image into digital text . the neural network is created using a trained IAM dataset that includes word pictures. While neural networks can be best executed on the GPU and CPU, all layers are only slightly combined with word pictures. Tensor flow is essential for the straight forward execution of handwritten text recognition .
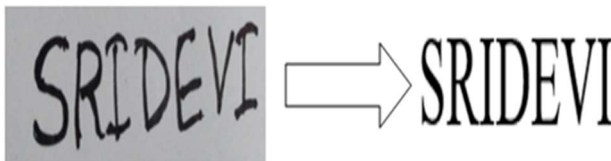

FIG 2: Conversion of scanned text into digital text

IV.DIGITAL TEXT CONVERSION USING ANN

The proposed works training portion entails the following steps: Creating a data set, preprocessing it, extracting features from it, creating a feature vector and text vector training and ANN and storing the ANN for testing.

The testing phase does not entail any ANN training, but it does require some additional pre-processing steps because we must determine how many letters are in the input image. Instead, it employs trained ANN immediately following the generation of the feature vectors. The segmentation is a crucial phase in the testing process since it determines the quantity of characters.

During the pre-processing stage, a number of procedures are carried out on the input image (in testing as well as training stages). It aids in improving the depiction of the image and qualifies it for segmentation pre-processing is mostly used to reduce background noise, highlight the area of interest in an image and create a distinct separation between the foreground and background. The input image is smoothed converted to binary, and noise-filtered in order to accomplish these objectives.

The compressed version of the input image is also used during the pre-processing. In order to choose the region of interest, edge detection is also carried out. A fairly good distinction between foreground and background is ensured by the conversion to binary. Edge dilating operations are also carried out within the pre-processing stage itself.

Only during the testing stage does an image segmentation take place. In this, an entire image is broke down into a carried out using edge detection and the distance between the several characters. Following segmentation, the sub-divided components are labelled before being treated individually. To determine how many characters are present throughout the entire image, this tagging is done. Next, each sub image is scaled and normalized against itself.

By doing so, it is possible to extract the images valuable qualities. The minima or arcs places in between the characters, which are relatively simple to locate in handwritten writings, are used to identify the scanned image for suitable segmentation sites. By comparing all of the segmentation points in the entire image, the segmentation points are also evaluated for only inclusion errors.

The pre-processed image is changed into a bit mapped version with a size of 75 to calculate the feature vector. A few samples of the bit map versions of various characters used in the suggested system. The bit map version uses less space and data while maintaining the main elements of the input image. ANN training should be done in a quicker manner while maintaining accurate character be done in a quicker manner while maintaining accurate character recognition.

Following that, the bit map images are transformed into a single 351-pixel vector that will be used as a vector for the ANN.

The hidden layers and selection algorithm must be made when training an ANN. So that training can be completed effectively, the input vector and target vector are both normalized in the [-1 to 1] range.

The gradient and maximum number of iterations are both set to e-10 during training. For the creation of the training dataset, 55 samples of each character were employed.

To validate the effectiveness of the method is devised, new test photos are currently being created.

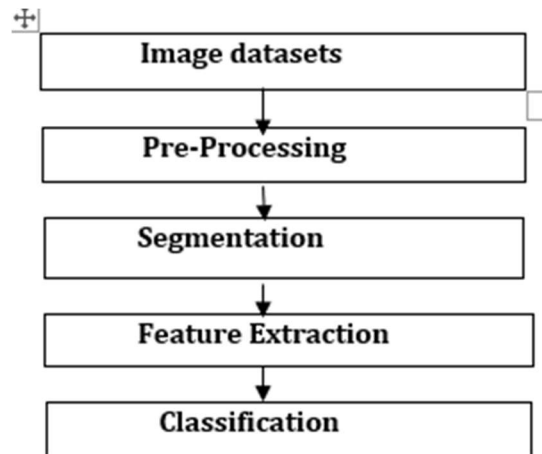## A. FLOW OF THE PROCESS FOR HANDWRITTEN RECOGNITION

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┌─────────────────────────┐
│     Image datasets      │
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            │
            ▼
┌─────────────────────────┐
│     Pre-Processing      │
└─────────────────────────┘
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│      Segmentation       │
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│   Feature Extraction    │
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┌─────────────────────────┐
│     Classification      │
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Image Datasets: Offline handwritten character recognition includes this stage .any digital instrument may be used as the image source. the image is captured by scanner or camera and moved on to the following stage

Pre-processing :Preprocessing is a series of steps that enhances image quality and, as a result ,increases image accuracy. the following preprocessing techniques are used for the handwritten character recognition process.

Noise-Removal: The process of reducing noise from an image is known as noise removal. by eliminating the undesirable signals in the image this also means smoothing the image. There are numerous algorithms for removing image noise. Gaussian filtering method ,Min-Max filtering method , Median filter etc. , are of them.

Segmentation: Segmentation is a method for removing specific characters from an image. Segmentation comes in two flavors .Both implicit and Explicit segmentation are used, In implicit segmentation the procedure of segmenting word is not used. however ,In Explicit segmentation, word are predicted using character be character.

Feature Extraction :The algorithm for recognition begins with this stage ,which is one of most crucial once. Each character possesses unique qualities, it consists of a set of rules ,each of which explain a character feature. In this phase, such traits are extracted .

Classification: The training would have ended by this point ,and the testing of the input data would have begun. the testing data would run through all of the aforementioned steps ,and different probabilities are given to the matching rules. The rule with the highest likelihood is chosen ,and the associated class-label is given recognizable character.

B. FRAMEWORK USE IN MACHINE LEARNING

Supervised Classification (Test Dataset):The test dataset accounts for 30% of the whole data set. The test data was subjected to supervised learning algorithms, and the results were compared to the actual results.

Pandas: Pandas is an open source, BSD-licensed library providing high-performance, easy-to-

use data structures and data analysis tools for the Python programming language.

NumPy: NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays. It is the fundamental package for scientific computing with Python.

Matplotlib: matplotlib. Pyplot is a plotting library used for 2D graphics in python programming language. It can be used in python scripts, shell, web application servers and other graphical user interface toolkits

Scikit-learn: Scikit-learn is a free machine learning library for Python. It features various algorithms like support vector machine, random forests, and

k-neighbors, and it also supports Python numerical and scientific libraries like NumPy and SciPy.

V. IMPLEMENTATION OF HANDWRITTEN TEXT RECOGNITION

The basic process of handwritten text recognition system was covered in this part.
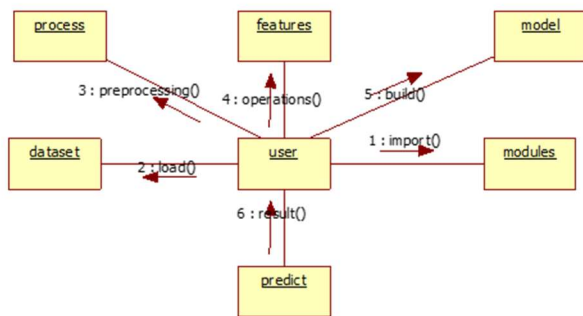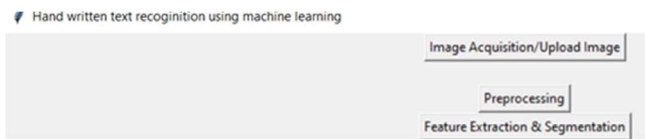

FIG 3 :Block diagram for handwritten text recognition

INPUT: scanning a form or document is a common example .this necessitates the extraction of individual characters from this scanned image.


DATASET: The initial requirements for creating a machine learning model is a dataset, as a machine learning model is entirely based on data. The data set is a collection of data in certain format for a specific problem. For analytic and prediction purposes, a collection data item that can be processed as a computer as a single unit.
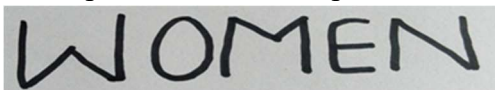
PREPROCESSING:

During the prepossessing stage, a series of operations are performed on the input image.
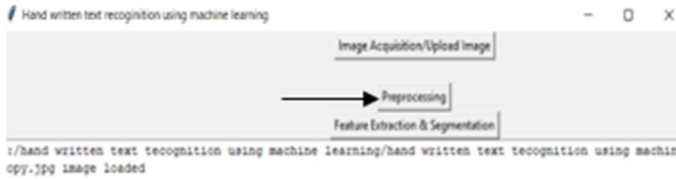
Data preprocessing is the procedure for preparing raw data for use in a machine learning model. It's the first and most important stage in building a machine learning model.

Real-world data sometimes contains noise, missing values, and is in an unsuitable format that cannot be used directly in machine learning models.

Data preprocessing is a necessary task for cleaning data and making it suitable for a machine learning model, which improves the model's accuracy and efficiency.

FEATURE EXTRACTION: Machine learning and deep learning feature extraction. The process of translating raw data into numerical features that may be handled while keeping the information in the original data set is known as feature extraction. It produces better outcomes than applying machine learning to raw data directly.

VI. RESULT AND DISCUSSION

We constructed a model for the research based on the inputs in various forms and the input and output.

We have developed two types of outputs from these inputs' photographs and the first of which is computerized text based output. Our model recognized and processed 5 of the 5 characters in the input image, and 5 of them were correctly recognized resulting in a 98% accuracy for this input and a 95% overall accuracy.

Input Image	Recognized Text
HIMANSHU	Below Extracted Text from Image HIMANSHU
TEA	Below Extracted Text from Image TEA
WOMEN	Below Extracted Text from Image WOMEN

CONCLUSION AND FUTURE SCOPE

The recognition of handwritten characters is a difficult problem to solve. The need revolves around datasets and databases. The model was created to analyze the content that we wrote and transform it to computer text.

Image feature extraction is constrained by a number of factors, including changes in image capture position and lighting circumstances at the time of capture. Because everyone has a different hand writing form, image identification in hand writing is more difficult. As a result, hand writing will be more difficult to detect than writing from computers that already have a defined standard form. There are various approaches presented with the artificial neural network method having the highest accuracy(ANN).No one will write with paper and a pen in the future since everything will be dependent on technology. In that situation, people wrote on touch pads, which allowed the built-in software to recognize the words they were writing hand turn it into digital text, greatly simplifying searching and comprehension.

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