HAND WRITTEN CHARACTER RECOGNITION SYSTEM USING MACHINE LEARNING

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ABSTRACT

Hand written character identification is a topic *that* has been researched for years and is an area of interest for the community of Pattern recognition researchers since it may be use in a wide range of fascinating applications all across the field. This subject is a difficult challenge as a task because each person has their own unique writing style. SVM, ANN, and CNN models are some of the available options for handling this problem's many ways and approaches. HCR is a need in the modern world since it assists us in a variety of fields of public domain, which makes it more vital to study. Off-line character recognition and online character recognition are both examples of the Hybrid Character Recognition (HCR) category. In this study, we review the many existing algorithms that have been implemented to get the better knowledge of the course, and we will conclude on the best strategies that are currently being developed for HCR.

1. INTRODUCTION

1.1 Introduction

Machine learning and deep learning play an important role in computer technology and artificial intelligence. With the use of deep learning and machine learning, human effort can be reduced in recognizing, learning, predictions and many more areas.

This article presents recognizing the handwritten characters (A to Z) from the famous MNIST dataset, comparing classifiers like KNN, PSVM, NN and convolution neural network on basis of performance, accuracy, time, sensitivity, positive productivity, and specificity with using different parameters with the classifiers.

To make machines more intelligent, the developers are diving into machine learning and deep learning techniques. A human learns to perform a task by practicing and repeating it again and again so that it memorizes how to perform the tasks. Then the neurons in his brain automatically trigger and they can quickly perform the task they have learned. Deep learning is also very similar to this. It uses different types of neural network architectures for different types of problems.

For example – object recognition, image and sound classification, object detection, image segmentation, etc.

Handwritten character recognition is the ability of computers to recognize human handwritten characters. It is a hard task for the machine because handwritten characters are not perfect and can be made with many different flavors. The

handwritten character recognition is the solution to this problem which uses the image of a character and recognizes the character present in the image.

1.2 Character Recognition System:

Character recognition system is the working of a machine to train itself or recognizing the characters from different sources like emails, bank cheque, papers, images, etc. and in different real-world scenarios for online handwriting recognition on computer tablets or system, recognize number plates of numeric entries in forms filled up by hand and so on.

1.3 Problem Statement:

The goal of this project is to create a model that will be able to recognize and determine handwritten characters from its image by using the concepts of Convolution Neural Network. Though the goal is to create a model which can recognize the characters, it can be extended to digits and an individual's handwriting. The major goal of the proposed system is understanding Convolutional Neural Network and applying it to the handwritten recognition system.

1.4 Relevant theory

The process of Handwritten Character Recognition (HWCR) often consists of many steps. Here, the first one is the Image Acquisition, and in this state, we take all of the possible images and obtain the input either by taking a picture with a camera or phone, or we can take it by drawing the image on a sheet of page, and after that, we can scan that using a scanner or the camera on our phone. Creating drawings with the light stylus is yet another type of image input that may potentially be used.

The subsequent step in the process is called pre-processing, and it is at this phase that the quality of the photos is enhanced and improved. After applying various procedures to the input photos, which may include thinning, skeletonization, normalizing, skew correction, noise removal, filtering, and binarization, During the process of preprocessing, we provide the photographs a higher standard of quality by improving and enhancing them.

The third stage of the system is called segmentation, and it is important for decomposing the input picture into meaningful pieces. Additionally, this procedure helps to separate the many things that are displayed in the object. A basic function shown in figure 1.3. Therefore, we are able to define segmentation as the condition in which the input is broken down into subparts, and each subpart is defined as an object

Throughout the subsequent step, we will be classifying the objects that were produced during the process of segmentation in order to make a determination regarding the category of item to which each individual object belongs. Therefore, when we are in this stage, it is possible for us to have classes that are dependent on the object. This is because numerous classes may be developed for categorization, and as we obtain the properties of the entity, we will be able to assign a class to all of the objects.

For illustration's sake, let's say we have a class called "car" and another class called "plane." At this point, any item that exhibits vehicle-like qualities must be assigned to the "car" class owing to the traits it possesses. In the same way as this

system, this review paper investigates the many approaches to HCR that are already in use and discusses both the benefits and drawbacks associated with each of them.

The use of a deep neural network (DNN), which, in addition to being an efficient feature extractor and classifier, as well as one of the many approaches that can be used, also happens to be one of the many approaches that can be taken to address this issue, is one of the many ways that this problem can be solved.. However, there is a catch, and that is the necessity for an excessively long period of time to train the network. This is because the network has a significant number of nonlinear hidden layers, in addition to certain connections. While Deep Neural Networks (DNN) were developed to solve these challenges, Convolutional Neural Networks (CNN) were developed to solve these problems by implementing nonlinear hidden layers in a smaller amount compared to DNN .

This is the key reason that we use CNN to extract the characteristics of position-invariant. CNN has a simpler structure compared to DNN, which is why we employ it. Because it provides the user with temporal subsampling and allows for a degree of rotation, shift invariance, and distortion, a map may be constructed between the input picture or dataset and the output dataset through the usage of a convolutional neural network with relative ease.

Fans of machine learning and data mining have already put in a significant amount of work to improve their chances of successfully approximating pattern recognition. Back checks are a perfect illustration of how dependent we are on HCR as a medium, which takes the information and lets us communicate with others. HCR has a significant effect on the way we live today because of how dependent we are on it.

The same debate occurs whenever we make use of the distortion of the HCR. This is due to the fact that various locations house a variety of languages, and these locations will also provide a variety of handwriting styles and methods. As a result, it is somewhat challenging to maintain control and extract the character from the language that is provided.

2. LITERATURE SURVEY AND RELATED WORK

An early notable attempt in the area of character recognition research is by Grimsdale in 1959. The origin of a great deal of research work in the early sixties was based on an approach known as analysis- by-synthesis method suggested by Eden in 1968. The great importance of Eden's work was that he formally proved that all handwritten characters are formed by a finite number of schematic features, a point that was implicitly included in previous works.

This notion was later used in all methods in syntactic (structural) approaches of character recognition.

1. **K. Gaurav, Bhatia P. K.** , his paper deals with the various pre-processing techniques involved in the character recognition with different kind of images ranges from a simple handwritten form based documents and documents containing colored and complex background and varied intensities.In this, different preprocessing techniques like skew detection and correction, image enhancement techniques of contrast stretching, binarization, noise removal techniques, normalization and segmentation, morphological processing techniques are discussed.

2. **Sandhya Arora** , used four feature extraction techniques namely, intersection, shadow feature, chain code histogram and straight line fitting features. Shadow features are computed globally for character image while intersection features, chain code histogram features and line fitting features are computed by dividing the character image into different segments. On experimentation with a dataset of 4900 samples the overall recognition rate observed was 92.80% for Devanagari characters.
3. **Brakensiek, J. Rottland, A. Kosmala, J. Rigoll**, in their paper a system for off-line cursive handwriting recognition is described which is based on Hidden Markov Models (HMM) using discrete and hybrid modelling techniques. Handwriting recognition experiments using a discrete and two different hybrid approaches, which consist of a discrete and semi-continuous structures, are compared. It is found that the recognition rate performance can be improved of a hybrid modelling technique for HMMs, which depends on a neural vector quantizer (hybrid MMI), compared to discrete and hybrid HMMs, based on tired mixture structure (hybrid - TP), which may be caused by a relative small data set.
4. **R. Bajaj, L. Dey, S. Chaudhari** , employed three different kinds of features, namely, the density features, moment features and descriptive component features for classification of Devanagari Numerals. They proposed multi classifier connectionist architecture for increasing the recognition reliability and they obtained 89.6% accuracy for handwritten Devanagari numerals.
5. **G. Pirlo and D. Impedovo** in his work on , presented a new class of membership functions, which are called Fuzzymembership functions (FMFs), for zoning-based classification. These FMFs can be easily adapted to the specific characteristics of a classification problem in order to maximize classification performance. In this research, a realcoded genetic algorithm is presented to find, in a single optimization procedure, the optimal FMF, together with the optimal zoning described by Voronoi tessellation. The experimental results, which are carried out in the field of handwritten digit and character recognition, indicate that optimal FMF performs better than other membership functions based on abstract level, ranked-level, and measurement-level weighting models, which can be found in the literature.
6. **Sushree Sangita Patnaik and Anup Kumar Panda** May 2011 , this paper proposes the implementation of particle swarm optimization (PSO) and bacterial foraging optimization (BFO) algorithms which are intended for optimal harmonic compensation by minimizing the undesirable losses occurring inside the APF itself. The efficiency and effectiveness of the implementation of two approaches are compared for two different conditions of supply. The total harmonic distortion (THD) in the source current which is a measure of APF performance is reduced drastically to nearly 1% by employing BFO. The results demonstrate that BFO outperforms the conventional and PSO based approaches by ensuring excellent functionality of APF and quick prevail over harmonics in the source current even under unbalanced supply.
7. **M. Hanmandlu, O.V. Ramana Murthy** have presented in their study the recognition of handwritten Hindi and English numerals by representing them in the form of exponential membership functions which serve as a fuzzy model. The recognition is carried out by modifying the exponential membership functions fitted to the fuzzy sets. These fuzzy sets are derived from features consisting of normalized distances obtained using the Box approach. The membership function is modified by two structural parameters that are estimated by

optimizing the entropy subject to the attainment of membership function to unity. The overall recognition rate is found to be 95% for Hindi numerals and 98.4% for English numerals.

3. EXISTING SYSTEM

In most of the existing systems recognition accuracy is heavily dependent on the quality of the input document. In handwritten text adjacent characters tend to be touched or overlapped. Therefore it is essential to segment a given string correctly into its character components. In most of the existing segmentation algorithms, human writing is evaluated empirically to deduce rules. But there is no guarantee for the optimum results of these heuristic rules in all styles of writing. Moreover handwriting varies from person to person and even for the same person it varies depending on mood, speed etc. This requires incorporating artificial neural networks, Hidden Markov models and statistical classifiers to extract segmentation rules based on numerical data.

Disadvantages:

1. High Complexity.
2. Difficult to analysis.
3. Time Consumption Is More

4. PROPOSED SYSTEM

The user can upload the image from the system's storage. The uploaded image is then processed in a neural network model (NN model) which identifies the characters, i.e., the digits, alphabets or special symbols. After identifying these characters, they are converted into text (printed text) and this processed document is sent back to the user as output.

Advantages

1. Less Complicated.
2. Easy to process
3. Accuracy is more

5. IMPLEMENTATION

MODULES

Basic steps in constructing a Machine Learning model:

Data Collection

- The quantity & quality of your data dictate how accurate our model is
- The outcome of this step is generally a representation of data (Guo simplifies to specifying a table) which we will use for training
- Using pre-collected data, by way of datasets from Kaggle, UCI, etc., still fits into this step.

Data Preparation

- Wrangle data and prepare it for training
- Clean that which may require it (remove duplicates, correct errors, deal with missing values, normalization, data type conversions, etc.)
- Randomize data, which erases the effects of the particular order in which we collected and/or otherwise prepared our data
- Visualize data to help detect relevant relationships between variables or class imbalances (bias alert!), or perform other exploratory analysis
- Split into training and evaluation sets

Choose a Model

Different algorithms are for different tasks; choose the right one.

Train the Model

- The goal of training is to answer a question or make a prediction correctly as often as possible
- Linear regression example: algorithm would need to learn values for m (or W) and b (x is input, y is output)
- Each iteration of process is a training step

Evaluate the Model

Uses some metric or combination of metrics to "measure" objective performance of model .Test the model against previously unseen data .This unseen data is meant to be somewhat representative of model performance in the real world, but still helps tune the model (as opposed to test data, which does not) .Good train/eval split? 80/20, 70/30, or similar, depending on domain, data availability, dataset particulars, etc.

Parameter Tuning

This step refers to hyperparameter tuning, which is an "artform" as opposed to a science Tune model parameters for improved performance Simple model hyperparameters may include: number of training steps, learning rate, initialization values and distribution, etc.

Make Predictions

Using further (test set) data which have, until this point, been withheld from the model (and for which class labels are known), are used to test the model; a better approximation of how the model will perform in the real world

4.1.8 Methodologies for Handwritten Character Recognition System

We used MNIST as a primary dataset to train the model, and it consists of 70,000 handwritten raster images from 250 different sources out of which 60,000 are used for training, and the rest are used for training validation. Our proposed

method mainly separated into stages, preprocessing, Model Construction, Training & Validation, Model Evaluation & Prediction. Since the loading dataset is necessary for any process, all the steps come after it.

5. RESULTS AND DISCUSSION SCREENSHOTS

HOMESCREEN

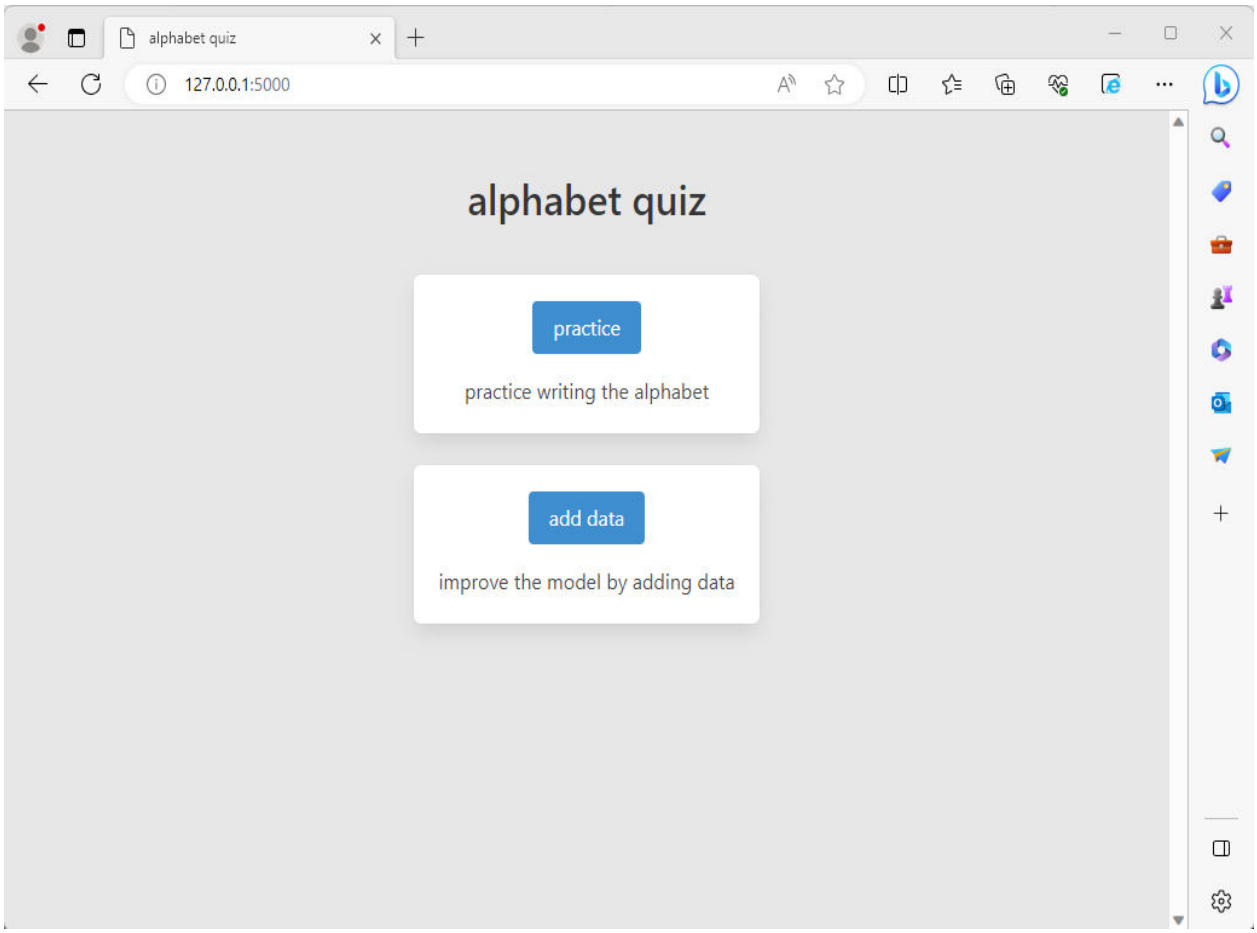

Fig 1 Home screen

UPLOAD IMAGE

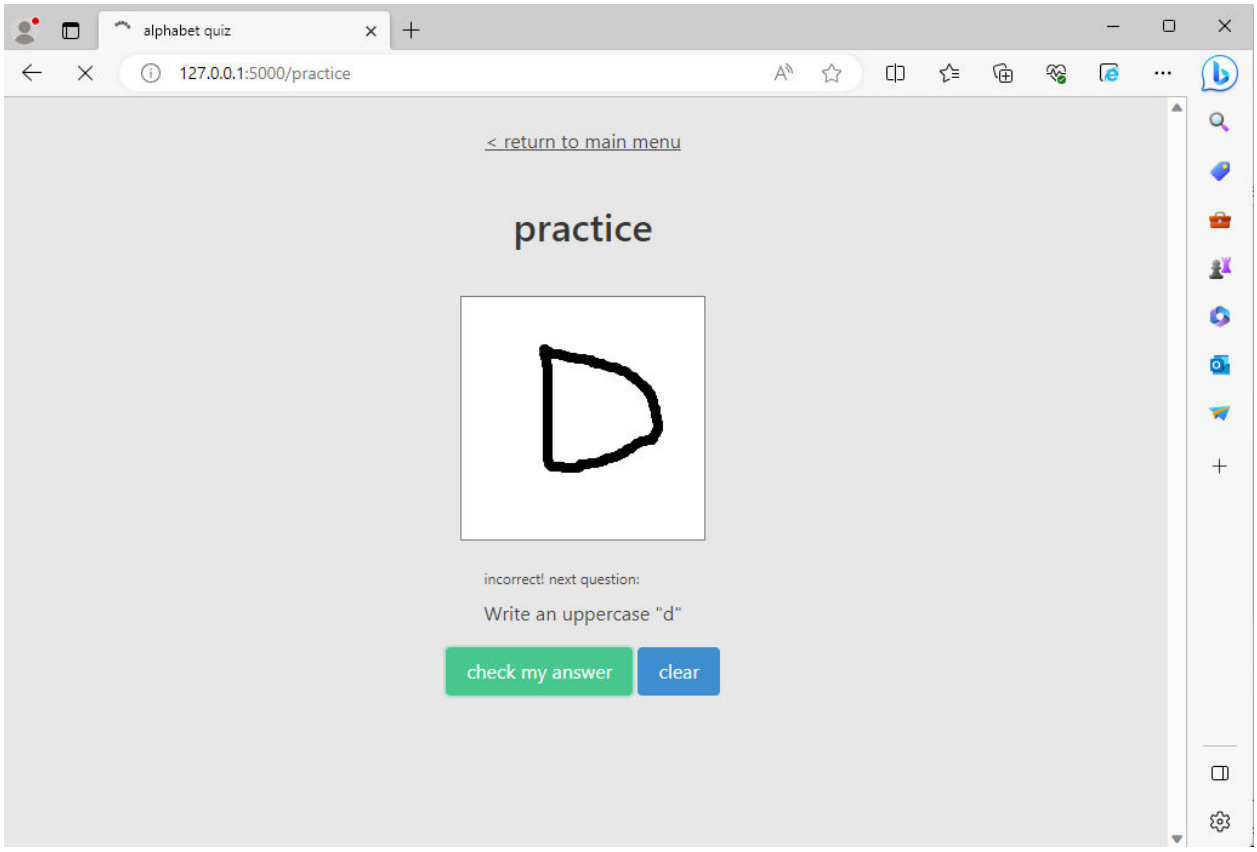

Fig 2- Upload Image

IMAGE UPLOAD

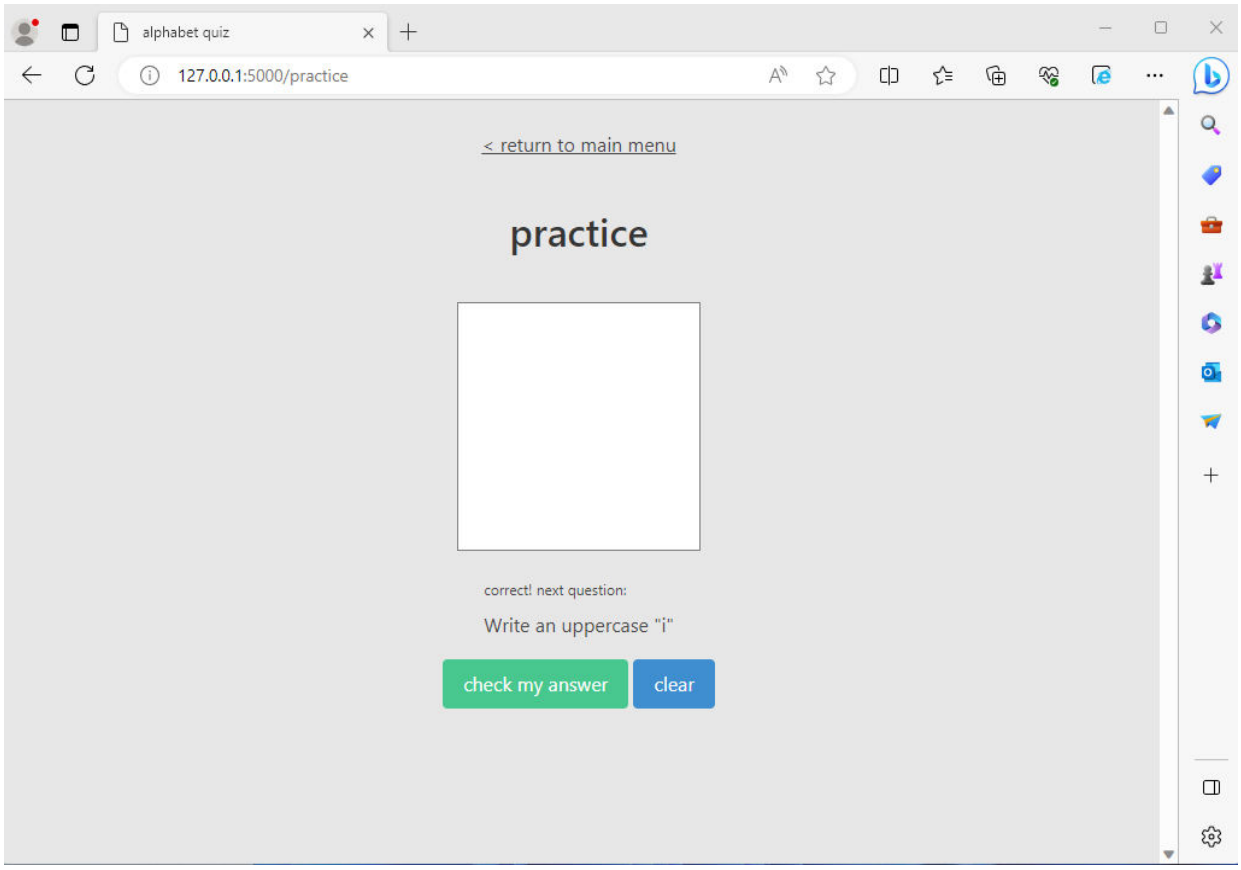

Fig 3- Image Upload

7. CONCLUSION AND FUTURE SCOPE

CONCLUSION

This article takes a comprehensive look at the most efficient, cutting-edge technologies and methods that have been used in HCR in the past. Although the amount of work that has been done in this field is substantial, the high demand for HCR necessitates the development of more effective and accurate algorithms that require less time and storage.

A complicated study topic has been presented as a result of the wide variety of human handwriting and the various character write-ups. This paper presents a concise analysis of all of the significant algorithms that were addressed. Researchers will get in-depth information of the ongoing work being done on this issue as a result of this study.

Handwritten Character Recognition Using Efficient Net B2 With Transfer Learning and Two Dense Layers Is the Focus of This Research This paper explores and concentrates on Handwritten Character Recognition using Dataset DHCD of Devanagari script, which has 92000 pictures of 46 distinct classes. Because these techniques scale all of the factors uniformly, unlike other CNN methodologies, which makes them superior, transfer learning model helps us in rapid

progressive accuracy of our result, and The EfficientNet are the face of CNN after their publication in 2019. This will happen in 2019 because these techniques scale all of the factors uniformly. In addition, two thick layers facilitate the processing of data through the utilization of metrics vector multiplication from all of the neurons in the layer that comes before it. Even if a vast amount of work has already been done in this sector, there is still a lot of research that needs to be done in order to achieve a high level of accuracy while taking into account a large time factor.

FUTURESCOPE

This article assists scholars in this sector in examining new methods and comparing them to one another, which might be useful for further research and development in the years to come. Our model's calculations are dependent on the size of the picture contained in the DCH dataset. A more complicated dataset may be utilized in the testing of our model, which may lead to outcomes that are distinct from those predicted by the model.

In addition, this precision may be enhanced by refining the tuning of a number of factors, although doing so may require a significant investment of time and may or may not be technically viable. This work is being presented as a starting effort, and the objective is to simplify the progress and process of identifying hand-written Indo characters. This yields an accuracy in validation that is 99.49 percent accurate.

HCR for Devanagari is carried out by the performance of a computational device that accepts input from documents, screens, photos, and other responsive devices and believe to provides output by reading those images as an ASCII or UNICODE format. This theory is supported by the fact that computers have become increasingly powerful in recent years. Sanskrit, Nepali, Marathi, and Hindi are some of the languages that are represented in Devanagari. This script is a blend of numerous languages. This implementation is more important because the design of upper-case and lower-case characters in Devanagari are more complicated than in most other languages out there. Comparatively speaking, the set of characters used in Devanagari is more complicated than the set of characters used in the English language. Character recognition has been hampered by the absence of verified datasets including Devanagari, which has made the task more difficult to do in the field.

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