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Handwritten Alphanumeric Recognition

T. Uday Kumar[1], M. Poorna Hari Priya[2], S. Rishitha[3], G. Sai Ram[4], B. Keerthi Renuka[5]

[1]Assistant Professor, Department of Computer Science and Engineering, Lakireddy Bali Reddy College of Engineering (Autonomous), Mylavaram,Krishna Dt, AP, India, 521230
[2,3,4,5]UG Students, Department of Computer Science and Engineering, Lakireddy Bali Reddy College of Engineering (Autonomous), Mylavaram,Krishna Dt, AP, India, 521230

Abstract: One way that developers are enabling machines to become more intelligent is by diving into machine learning and deep learning techniques. The process of learning how to perform a task is best described as "repeating it again and again in order to make it solid in your memory." It is the ability to read the handwritten alphanumeric characters either digit or alphabet, without human assistance. Handwritten characters can be made in many different ways, and that makes it difficult for the machine to decipher them. This application, which utilises both written and image data, helps solve this problem because it allows us to use handwritten alphanumeric characters and alphabet characters both together and for recognising data in images. We follow specific steps in order to build this handwritten alphanumeric recognition. By using deep learning algorithms such as CNN, RNN, we plan to implement face recognition to identify data written.

Keywords: Convolution Neural Network, Recurrent Neural Network, TensorFlow, IAM dataset, deep learning.

1. INTRODUCTION

Artificial neural networks and image processing are both utilised to interpret handwritten alphanumeric input, and a handwritten alphanumeric recognition system is in use for visualising the input images. This system is commonly applied in processing bank checks, post office addresses, and cell phones, among other things. The knowledge required to perform alphanumeric recognition includes a basic understanding of neural networks and image processing. Computational intelligence techniques like artificial neural networks or fuzzy logic may be found in some of the existing systems, whereas other systems are large lookup tables that contain all the handwritten Alphanumeric values. Using CNN and RNN to identify the character in the image is a good way to start using deep learning algorithms. Convolutional neural networks (CNNs) have recently found an increasing number of practical applications in areas like image processing, machine learning, and have, in contrast, had less success in recreating traditional recurrent neural networks (RNNs). Also, CNN and RNN are useful in image classification, which is extremely helpful for handwritten alphanumeric recognition.

a) IAM database

The IAM Handwriting Database contains forms of handwritten English text which can be used to train and test handwritten text recognizers and to perform writer identification and verification experiments. The database contains forms of unconstrained handwritten text, which were scanned at a resolution of 300dpi and saved as PNG images with 256 gray levels. The figure below provides samples of a complete form, a text line and some extracted words.

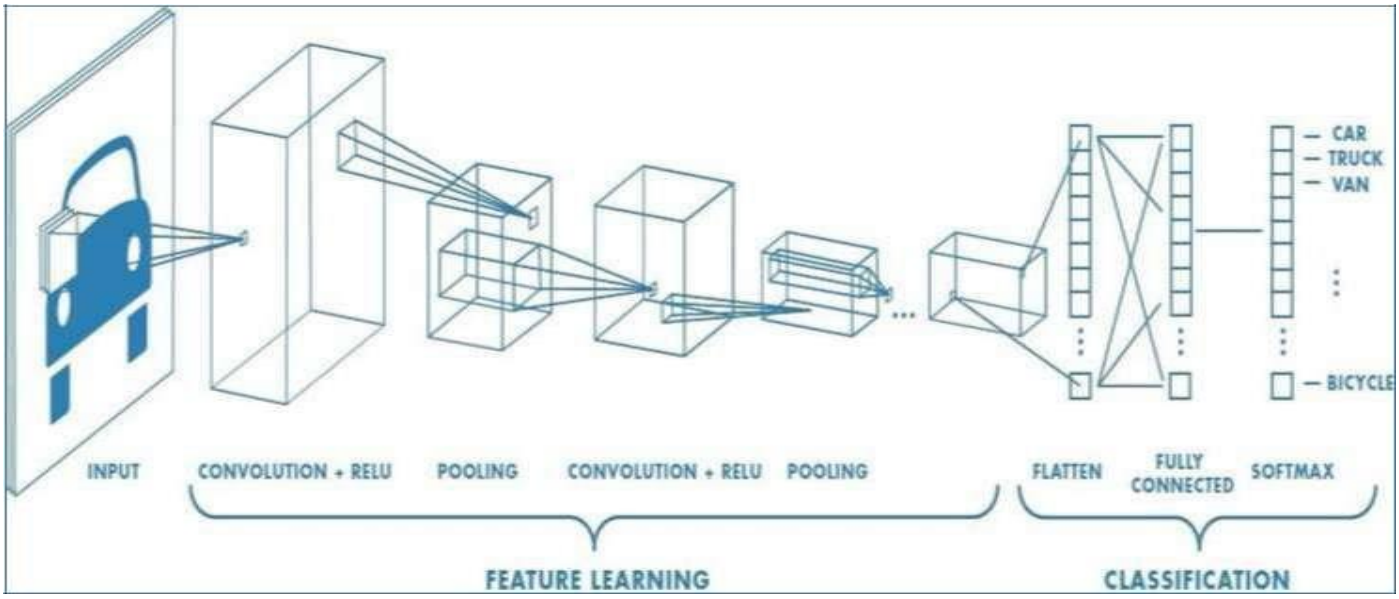
b) **CNN**

Deep artificial neural networks algorithm (DANN) is the concept of CNNs. CNN is helpful in image processing, which is why it is widely used for image classification, data clustering, and pattern recognition, particularly in scenes. According to CNN, there are three distinct layers to processing a task: the input layer, the output layer, and the hidden layers. The Convolution Layers, RELU Layers, Pooling Layers, and Fully Connected Layers will commonly perform all of CNN by dividing into four separate layers: - Convolution Layers, RELU Layers, Pooling Layers, and Fully Connected Layers. In order to extract features from the input image, CNN will apply many different filters, extract the features, and then arrange them into Feature Maps. In RGB, there is a lot of data that has to be stored. Colours as well as features "Whereas Gray-Scale can be considered as either 0 or 1, which reduces the amount of data to process and shortens processing time" (Time complexity).

CNN Steps:-

- **Step 1** : Convolution Operation
- **Step 1(b):** RELU Layer (REctified Linear Unit)
- **Step 2:** Pooling
- **Step 3:** Flattening
- **Step 4:** Full Connection
- **Step 5:** Soft Max & Cross -Entropy

Block Diagram of CNN



c) **RNN**

Recurrent Neural Network (RNN) is used in Deep Learning and in the development of models that will imitate the activity of neurons those are designed to recognize patterns in Handwritten and Numerical. RNN follows a Sequential Approach. **Applications**: Automatic Image Trigger, Speech Recognition, Sentiment Analysis, Machine Translation.

Working Of RNN

- For calculating the current state: **ht =f(ht-1, Xt)**
- To apply the activation function tanh, we have:
  ht = tanh (Whhht-1+ Wx hXt)

- The formula for calculating output**: Yt = WhyhtTraining of RNN:**
- It uses Back propagation algorithm , but it is applied for each timestamp commonly known as Back-propagation by Time (BTT).

Related Work

Handwritten Alphanumeric Recognition is one of the very helpful applications which can be used in many active areas of researches such as Offline Recognition, Online Recognition, Real- Time Recognition, Postal- Address Interpretation, Bank- Check Processing and Writer Recognition. We can recognize digits [1, 2, 3…] and alphabets [A, B….a, b...] which are in a picture format and display the characters or digits those are in the image in our output window. In further we can extend this application for Symbols [!, @, #, %, &…] as well along with Alphabets and digits.

Proposed System

- The Handwritten Alphanumeric Recognition System consist of the following steps:

1. We have to download IAM Dataset and the collect images.
2. After collecting the images from IAM Dataset, we have to divide them into Training and Testing images.
3. For both Training and testing sets we have to apply Pre- Processing Techniques.
4. Normalize the Pre- Processed data so that it lies between range of 0 and 1.
5. In order to train the system divide the Training dataset into different clusters based upon suitable size.
6. Apply the CNN & RNN algorithms on the above clusters in order to label the data.
7. Perform the classification on the trained dataset model.
8. Now analyze the features as well as the Space and Time complexities taken in order to recognize characters.

2. METHODOLOGY

Deep learning can be used as a central tool for solving a variety of issues, such as improving image comprehension, automating speech, and enhancing sensory experience. In order to solve handwritten alphanumeric recognition, we are using concepts from CNNs and RNNs with Beam Search Algorithm in the background. The primary goal of the proposed model is to understand CNN, RNN, and how to apply them to the Handwritten Alphanumeric

Recognition System. To obtain the basic features maps from images, use a Convolutional Neural Network. To extract the features from the feature maps, first apply RNN.

Functional Requirements:

- The input image given to the system by an user should be in format (PNG).
- If the input format is other than the mentioned then it should display an error message, "Format Not Matched".
- The System should process, analyze and then extract the features and patterns of the characters in the image accuratelyand show as the output for the user.

Non Functional Requirements:

- Performance: The characters in the input image must be recognized with an accuracy of 75% and more.
- Availability: In order to extract the text from input image, first the image should contain characters.
- Flexibility: System should provide the user friendly Interface in order to upload the input flexibly.
- Reliability: The given input image should contain compulsorily pure White background for the text.

3. RESULTS

GUI Interface

Input Format

Output Format- 1

Output Format- 2

4. CONCLUSION

Convolutional Neural Networks (CNNs and RNNs) are utilized in order to scan and identify

specific digits and alphabets in an input image. Neural Networks, Image Processing, and Deep Learning are greatly benefitted by handwritten alphanumeric recognition. We will be able to implement this handwritten alphanumeric recognition system to recognize both characters and symbols in the future. With these three resources, CNN, RNN, and Beam Search algorithms, the "Handwritten Alphanumeric Recognition" System has an accuracy rate of approximately 75%.

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