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HAND WRITTEN AND NATURAL SCENE CHARACTER RECOGNITION

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Abstract - *This paper presents handwritten character recognition (HCR) for English alphabets and digits. This model has two type of recognition method, one is recognition through drawing letters and another is recognition of characters from natural scene picture images. The idea is to either draw any character by dragging mouse in the given screen or to take image through camera or browse for recognizing the letter and the results are quite encouraging in terms of training and validation of characters in the model. We got 82% accuracy in this model which is quite good. Natural scene character recognition system is robust enough to handle various noise parameters in the image including strong distortions, poor background, low resolution and non-uniform lightning. We have used convolutional neural network for building the recognition model.*

Key Words: **Deep Learning, Computer Vision, Artificial Intelligence, Neural Networks, Pattern Recognition.**

1. INTRODUCTION

This project "Hand written and natural scene character recognition" is a user interactive software for recognizing both cased characters and digits. The input can be given either by drawing character using mouse, or by uploading pre-drawn or any natural scene image of a character, or by giving live input of characters using web cam, with sufficient light and intensity that the computer can at least differentiate between black and white.

This is an extended version of traditional OCR, as recognition of characters from natural scene images or computer font is also possible in this project. It is a problem of pattern recognition, where patterns are characters and digits. Though already a lot of research and work has been done in this field, it is still going on to improve the overall results and performance. It basically takes images of single character, processes it using computer vision applications, and predicts the corresponding character by using the pre-trained deep convolutional neural network model.

1.1 Why Convolutional Neural Network?

A Convolutional Neural Network (CNN) is comprised of one or more convolutional layers with one or more fully connected layers as in a standard multilayer neural network. Deep convolutional neural network (CNN) has become the architecture of choice for complex vision recognition problems for several years [7]. The architecture of a CNN is designed to take advantage of the 2D structure of an input image (or other 2D input such as a speech signal). This is achieved with local connections and tied weights followed by some form of pooling which results in translation invariant features. Another benefit of CNNs is that they are easier to train and have many fewer parameters than fully connected networks with the same number of hidden units. There has been a lot of research on using deep CNN to recognize handwritten digits, English alphabets, or the more general Latin alphabets [8].

1.2 Character Recognition

The importance of extraction & recognition of textual characters from digital images has increased a lot these days especially with the growing market of smart phones. Human beings have great ability to recognize the characters or text appearing in the images. We often wish to extract character or complete text from the digital images. One of the simple applications of this could be the extraction of picture messages on mobile phones and sending the text messages only rather than complete image file. Alternatively the text may form an input to some system for further processing. This may also have great applications in developing learning materials with both text & images together [9, 10].

Recognition from natural scenes requires little different approach than simple OCR application where characters can be represented on some matrix of numeric points. Actually there are still quite big issues in processing this kind of images. Few improvements in the form of some Google services such as Translator exists which are capable of detecting and translating text from images. However, results highly depend on the quality of the picture and on the environmental conditions (night/day, light/shadow) in which it was taken [11, 12].

Various means, particularly our smart phones, have been producing a huge amount of images and videos which are continuously streamed on social platforms. Therefore such solutions will always find some attention & interest.

Machine learning, obviously plays a very significant role in this field. Automatic text detection and character recognition is just an example. One can cite other sophisticated applications such as animal species or plants identification, human beings detection or, more in general, extraction of any kind of information of commercial use.

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items consecutively in square brackets (e.g. [1]). However the authors name can be used along with the reference number in the running text. The order of reference in the running text should match with the list of references at the end of the paper.

2. LITERATURE SURVEY

Character recognition as proposed in [1], by using the technique of artificial neural network (ANN). It introduced the offline and online recognition of different natural languages. HCR is the optical character recognition method which converts textual document into the machine-readable form. They also used OCR characters in this model for recognition that helps to increase the accuracy of recognition method. Now we are increasing the complexity of characters. Users can draw character on the screen and our model recognizes it. This is big gain of our model in comparison to other one. This model has increased the level of recognition in natural scene as well as in handwritten recognition.

As given in [2], the paper deals with the natural language processing and optical character recognition (OCR) technology. The printed and handwritten character (in the form of images) are recognized in the given model using different techniques of NLP. This model used NLP techniques that are not quite balanced for this model so we have found the new area of recognition that is CNN. Now CNN is very useful for machine learning techniques that are good enough for character recognition or handwritten character recognition.

Another method Kohonen network as used in [3], it shows about recognition of the handwritten characters using artificial neural network. The use of Kohonen self-organization map for pattern classification which employs unsupervised learning algorithm in this model. The result of this technique, handwritten character recognition is quite excellent. The model of handwritten character recognition using kohonen network is quite impressive but, in our model, we can do better work by using a more powerful convolutional neural networks.

The paper [4] proposed Handwritten Character Recognition (HCR) in English language. The HCR has been applied in variety of applications like such organizations where handwritten documents are dealt with. HCR is the process of conversion of handwritten character into machine readable form. For handwritten characters there are difficulties like it differs from one writer to another, even when same person writes same character there is difference in shape, size and position of character. Latest research in this field has used different types of classifiers, features and methods to reduce the difficulties of recognizing handwritten characters.

As discussed by [5], various techniques have been proposed for character recognition in HCR system. Even very much sufficient studies and papers describes the techniques for converting character from a paper document into machine readable form.

3. PROPOSED METHODOLOGY

Author	Classifier	Accuracy
Surya Nath R S,	KNN, SVM	99.9%
Bindu S Moni	MQDF	95.32%
Mamatha H R	KNN	90.5%
Angshul majumdar	KNN	96.8%
Sukhpreet Singh	SVM	94.29%
Alvaro Gonzalaz	KNN	85.8%

We have used convolutional neural network model that performs feature extraction on the various images (samples) given to it and after trainig, it is able to recognize any hand-written character or character in the natural scene image given to them. Separate architectures are used in both the modules and one of them is discussed in the next portion.

A. Algorithm for fixed pre-training module 2 – hand written character recognition

Step1 create_convnet (X_train, Y_train, X_test, Y_test)

- We have created convolutional neural network using 2 convolutional layers with relu activation function, each followed by max pooling layer and normalization.
- The output of above layers is given to fully connected layer with dropout 0.8 and further to a fully connected layer(ANN) with softmax activation function.

Step2 train (optimizer = “adam”, learning_rate = 0.01, n_epoch = 10)

- After creating network, training is done with the following parameters:-
  - Optimizer = Adam
  - Learning_rate = 0.01
  - N_epoch = 10

The following figure describes a complete flow of steps involved in the development of the system.

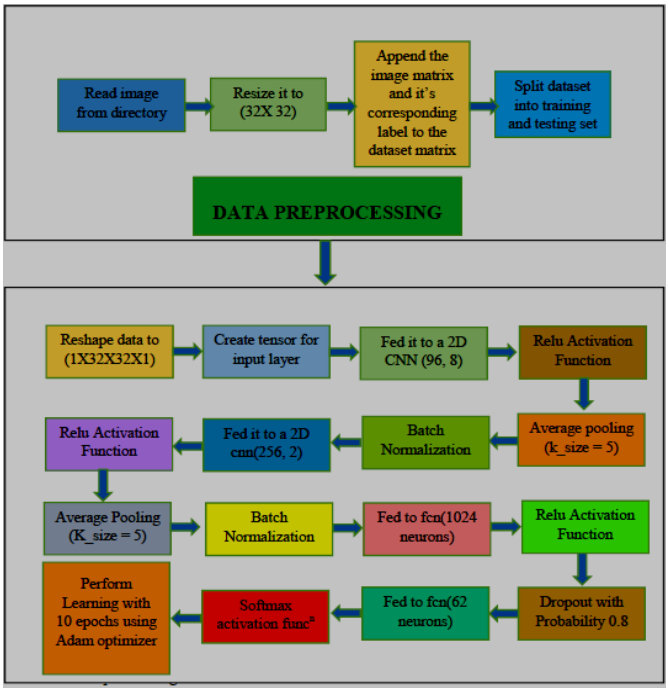

Fig1. (Architecture of Module 1: Character recognition from natural scene images)

Step3 Predict (img)

- Draw image of the character, you want to predict, on the canvas, using mouse drag.
- The image will be given to classifier to predict it's class.

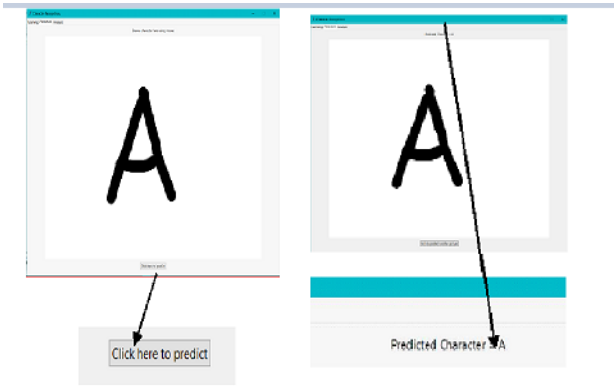

Fig.1 Steps to predict a character

Step4 learn(img)

- Select the character whose samples you want to train, select number of samples you want to give.
- Draw samples of the character.
- After samples given, click on start training.

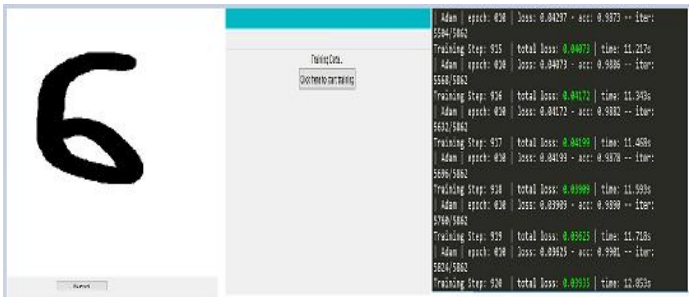

Fig. 2: Steps to train model by giving samples by drawing images

4. RESULTS

The results for recognition are two type, one is training result and other is validation or testing result which used for getting the accuracy of unknown inputs written by users that are shown in the table below -

Training and validation:

Samples of each class	Total samples	Train Test Ratio	Training Accuracy	Validation accuracy
105	6510	9:1	**98%**	**76%**

Prediction/testing:

Character	Samples Tested	Acuuracy
0	4	60%
1	5	80%
2	5	100%
3	5	80%
4	5	100%
5	5	100%
6	5	60%
7	5	100%
8	5	60%
9	5	80%
A	5	100%
B	5	80%
C	5	80%
D	5	80%
E	5	100%
F	5	100%
G	5	80%
H	5	80%
I	5	80%
J	5	80%
K	5	100%
L	5	80%

M	5	80%
N	5	80%
O	5	100%
P	5	100%
Q	5	100%
R	5	60%
S	5	80%
T	5	80%
U	5	80%
V	5	80%
W	5	100%
X	5	100%
Y	5	100%
Z	5	100%
A	5	80%
B	5	100%
C	5	80%
D	5	80%
E	5	40%
F	5	80%
G	5	80%
H	5	60%
I	5	60%
J	5	80%
K	5	100%
L	5	60%
M	5	80%
N	5	60%
O	5	100%
P	5	100%
Q	5	100%
R	5	60%
S	5	60%
T	5	80%
U	5	100%
V	5	100%
W	5	80%
X	5	80%
Y	5	80%
Z	5	100
Average accuracy =		**81.93%**

As from results we get the accuracy of whole model that is 81.93% which is quite good for recognition method using CNN. This model shows that how each and every letter gives good accuracy in recognition process. The result is quite good and increases with the increase of samples. This model aims for getting good accuracy for unknown inputs, which it has achieved to a significant extent.

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