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CNN based Hand Written Text Recognition System

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Abstract - *Using dedicated hardware to do machine learning typically ends up in disaster because of cost, obsolescence, and poor software. The popularization of Graphic Processing Units (GPUs), which are now available on every PC, provides an attractive alternative. We propose a fully connected neural network GPU implementation with implementation of CNN algorithm to recognize text in an image. There are many scripts in the world, several of which are used by hundreds of millions of people. Handwritten character recognition studies of several of these scripts are found in the literature. However, convolutional neural network (CNN) has recently been used as an efficient unsupervised feature vector extractor. It is more efficient as a feature extractor than as a classifier. we performed certain amount of training of as-layer CNN for a moderately large class character recognition problem. We used this CNN trained model for a recognizing text of handwritten form in English and output it in a document*

Key Words: CNN, Handwritten, Text, GPU, OCR

1. INTRODUCTION

OCR and on-line handwritten recognition are computationally expensive. Training time is a major bottleneck for improving handwriting recognition. Using dedicated hardware to do machine learning most often ends up in disaster. The hardware is typically expensive, unreliable, without libraries, poorly documented.

The situation has changed recently with the popularization of Graphic Processing Units (GPUs). The GPU is a single-chip processor that is designed to accelerate the real-time three-dimensional (3D) graphics that are displayed to a user. Initially a feature of high-end graphics workstations, the GPU has found its way onto the personal computer as an enhancer of graphics functions for which a conventional central processing unit (CPU) was too slow.

Since recent advancement in development of GPUs and how powerful high-end GPUs tend to be, we used our GPUs to train our model. After researching on several machine learning algorithms such as SVM, decision trees, HMM. We have found that CNN works the best when combined with GPU to output most optimum result.

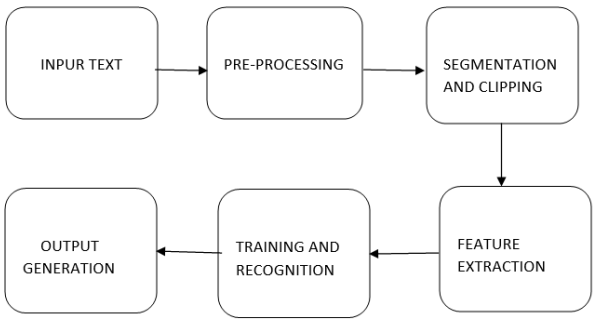
1.1 FUNDAMENTALS

The main purpose of the system is to scan the images of hand written text and return an output with correct prediction of correct text after recognizing it. **PROBLEM STATEMENT**

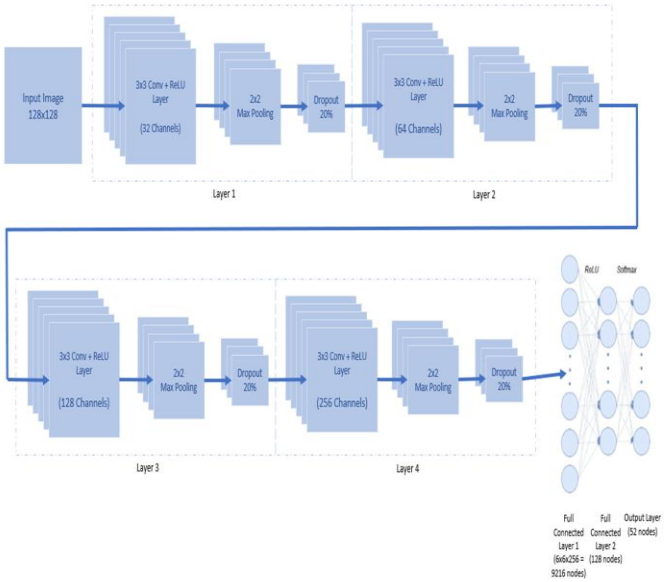
Designing a system for recognizing and correctly predicting the given handwritten text in English. While predicting the output there are various parameters to be considered such as inaccuracy of handwritten text, curves and fonts of written text, the system will predict the outcome based on the percentage of how close the letter resembles the official letters in English Script.

2. ARCHITECTURE

BLOCK DIAGRAM OF THE SYSTEM FLOW



In deep learning, there is a class called convolutional neural network, most commonly applied to analyzing visual imagery. We will be using 7-layer CNN algorithm's architecture as our base reference system for recognition of text.



Fig(1): Proposed System Architecture

The stages of the CNN method for image recognition in writing as below:

2.1 Pre-Processing: The image is resized, if too large then the calculation will be high or too small will be difficult to adjust to large networks. Larger images are cut and padding will be applied to smaller images to get the standard size. Noise filtering, smoothing and standardization are to be done in this stage.

2.2 Creation of datasets: an open source dataset is used from the following website: https://www.kaggle.com/crawford/emnist

2.3 Final Data Determination: A large dataset is required to train CNN. To achieve this, the images that have been obtained are modified and changed to get a large number of variations

2.4 Classification: The CNN end layer is the SoftMax layer and the SoftMax layer is used to classify the given input image

2.5 Testing: The test module is related to the test image. The test images were obtained by splitting the randomly enlarged dataset.

3. IMPLEMENTATION

SOFTWARE PLATFORM

3.1 *Tensorflow*

TensorFlow is an amazing information stream in machine learning library made by the Brain Team of Google and made open source in 2015.It is intended to ease the use and broadly relevant to both numeric and neural system issues just as different spaces. Fundamentally, TensorFlow is a low-level tool for doing entangled math and it targets specialists who recognize what they're doing to construct exploratory learning structures, to play around with them and to transform them into running programs. For the most, it can be considered as a programming framework in which one can entitle to calculations as graphs. Nodes in the graph speak the math activities, and the edges contain the multi-dimensional information clusters (tensors) related between them.

3.2 Python 3.7

Python is broadly utilized universally and is a high-level programming language. It was primarily introduced for prominence on code, and its language structure enables software engineers to express ideas in fewer lines of code. Python is a programming language that gives you a chance to work rapidly and coordinate frameworks more effectively.

3.3 Anaconda3

Anaconda is a free and open-source appropriation of the Python and R programming for logical figuring like information science, AI applications, large-scale information preparing, prescient investigation, and so forth. Anaconda accompanies in excess of 1000s of packages just as the Conda package and virtual environment director, called Anaconda Navigator, so it takes out the need to figure out how to introduce every library freely. Anaconda Navigator is a graphical UI (GUI) incorporated into Anaconda appropriation that enables clients to dispatch applications and oversee conda packages, conditions and channels without utilizing command line directions.

HARDWARE PLATFORM

3.4 NVIDIA GeForce Graphic Card:

Nvidia Corporation who specializes in manufacturing high quality Graphical Processing Units (GPUs)) for the gaming, graphic work and simulation. We have used a NVIDIA RTX 2060 GPU for training our model.

ALLOCATIONG GPU MEMORY TO TENSONFLOW

Run this piece of code before starting the program

PYTHON CODE:

```
import tensorflow as tf

gpus = tf.config.experimental.list_physical_devices('GPU')

try:
```

tf.config.experimental.set_memory_growth(gpus[0], True)

except RuntimeError as e:

 # Memory growth must be set before GPUs have been initialized

print(e)

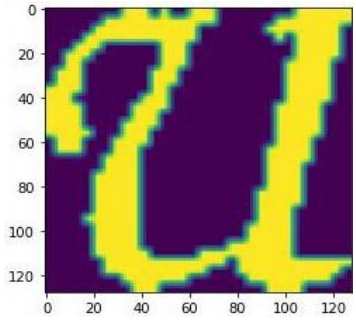
4. RESULT

We have implemented a generic 7-layer fully connected neural network using the Pixel Shader and languages for the GPU. These typically represent a very small fraction of the computation for the end-to-end system. These results must be interpreted with caution. Memory speeds plays a significant role on the performance. Handwritten Character data are very much essential for this work for training and testing the proposed Handwritten Character Recognition System

In English alphabets 26 characters and as well as in numerical 10 characters are to be developed in different forms. For example take the character "U", this character can be written in different various forms. For Training the character data we used Convolutional Neural Network algorithm. For this reason, the character data is to be taken and recognize what character it is

The following are the results achieved after implementation:

4.1



Fig(4.1) letter U prediction

Letter prediction : U

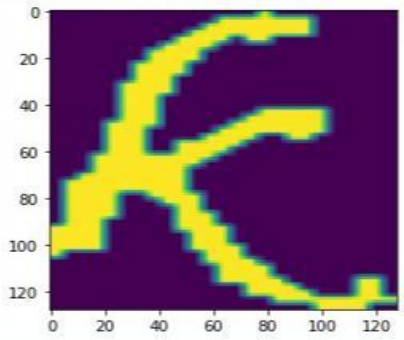
Percentage 94.12%

Second best

Prediction : u

Percentage : 3.57%

4.2



Fig(4.2) letter K prediction

Letter prediction : K

Percentage : 61.16%

Second best

Prediction : k

Percentage : 37.84%

Above output explains how the character is to be drawn and learns the character database and calculate percentage. Based on percentage we can recognize the character. The above screenshots explains how the character set is to be learned based on that we can display the learning graph.

MODEL EVALUATION RESULTS:

MODEL LOSS = 0.3740

ACCURACY = 0.8598

ACCURACY PERCENTAGE = 85.98 %

5. CONCLUSIONS

The goal of this is to implement a feature extraction strategy which can be used in any character recognition problem. Here, we have shown that if a CNN is trained for a sufficiently large class problem, it can be used for extraction of features of any other character set and the resulting system is still capable of providing high recognition accuracies. In the present study, we used the popular SVM classifier. Other classifiers may be tested along with this feature vector in future studies. Also, in future, we plan to use a CNN trained with some other data different from character images and check whether the same remains capable of providing comparable accuracies on character recognition tasks. This strategy should help to train recognizers for a new script for which no such recognizer exists. Although it is now an established fact that CNN is sufficiently efficient in character recognition tasks, but it has not been widely used due to the difficulty faced in its

training. However, in the present approach we did not allow the pain to train the CNN architecture through fine-tuning of its parameter. On the other hand, we trained this architecture until we achieved only moderate recognition performance.

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