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IMPLEMENTATION OF OCR(OPTICAL CHARACTER RECOGNITION) IN E-F.I.R. SYSTEM USING RESIDUAL NEURAL NETWORKS AND DEEP LEARNING

Pradyumn Misra [1] ,Anurag Dingar [2]

[1]8th semester, Dept. Of Computer Science, S.R.M. Institute of Technology, Ghaziabad, India
[2]8th semester, Dept. Of Computer Science, S.R.M. Institute of Technology, Ghaziabad, India

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Abstract -Strive to advance E-policing methods, this paper acquaints an idea to render better techniques to increase transparency, clarity, and better expression in the system of filing an E-FIR. The proposed system can be perceived as the standard operating procedure in which a handwritten FIR from the complainant will be converted into an E-F.I.R. using Optical Character Recognition(OCR) and will be available to the concerned authorities. To increase the efficiency and accuracy of the recognition of characters and symbols, an optimized model is designed using Deep learning. Thorough use of Deep Residual Neural Networks(ResNet) with optimum layers is inculcated in the model to receive to utmost clarification in the features at the lower level of layers to get the accurate distinction between character and symbols. A wide variety of databases namely CEDAR, MNIST, IAM, Kaggle is proposed for a broader spectrum of character recognition from English, Indian and Urdu script. The absolute aim of the paper is to provide advanced, accurate, and efficient lodging of E-F.I.R removing ambiguities or any kind of discrepancies from a handwritten F.I.Rs. submitted online and provide authorities with clean textual E-F.I.R.

Key Words: E-Policing, E-F.I.R.,Optical Character Recognition(OCR),Deep Learning, Residual Neural Networks(Resnet)

1.INTRODUCTION

In the contemporary world, technology has commendably assisted e-governance in setting a benchmark for enhancing the efficiency in the governance of the estate. The smoothness of execution of civic procedures has not only made things simple for the authorities but also the citizens. Digitization of processes have played a vital role in providing the sustainable use of resources but also increased accountability and transparency in the procedures The main section of the government that needs to utmost technical assistance is the police department. Advancements in e-policing measures can be proven as the greatest boon to mankind and will also lead to better law and order conditions ensuing in a better society for living beings. This paper revolves around building an exceptional technology by use of which a complainant can submit a handwritten F.I.Rs. and the F.I.Rs will be collected, synthesized, and analyzed using an OCR model designed using deep learning involving residual neural networks with an optimum number of layers for refining the features till the depth of the lowest layer. Model is slowly trained for better learning so that the distinction between similar character and symbols can be made with high accuracy

2. IMPLEMENTATION OF OCR

Implementation of the process from submitting the written F.I.R. by the complainant to receiving the E-F.I.R by the authorities is described in 6 steps:

1) IMAGE ACQUISITION

In image acquisition, written FIR is uploaded by the complainant and scanned by the OCR scanner. An OCR scanner should be able to threshold image i.e. it should replace every pixel with either a black or white pixel, the process is known as image segmentation

2) PREPROCESSING

The foremost aim of preprocessing is to make raw data usable by the model. The noise level optimization on an image is made and areas that are off text are removed. preprocessing yield better image recognition results

3) SEGMENTATION

process of segmentation is aimed at the grouping of significant characters into a cluster and create predefined classes for characters so that template matching can be performed between scanned image and predefined classes

4) FEATURE EXTRACTION

This step means splitting the input data into a set of essential characteristics that make one or another recognizable pattern

5) TRAINING A NEURAL NETWORK

After extraction of the features, they are fetched into a residual neural network(ResNet) model to train it for character recognition. A training dataset is achieved for the best output. Wider the database accurate will be the output

6) POST PROCESSING

The last stage is the process of refinement as it can require some corrections. However full accuracy can never be attained

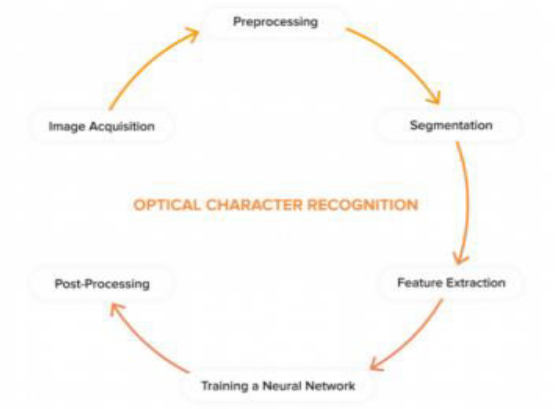

Fig 1: Implementation of OCR

3. USED DATASET

1) KAGGLE

Kaggle A-Z dataset by Sachin Patel, based on the NIST Special Database 19 is used in this project. This dataset actually covers 62 ASCII hexadecimal characters corresponding to the digits 0-9, capital letters A-Z, and lowercase letters a-z.

Fig 2: Kaggle dataset

2) MNIST

The MNIST dataset is acknowledged one of the most used datasets for handwritten digits. It is the subset of the NIST dataset. NIST consists of 60,000 pieces of training and 10,000 test images. In this samples are reserved at an aspect ratio of 20× 20 in form of greyscale images and the normalized images are of size 28 × 28. The data set tremendously reduces the preprocessing and formatting time.

Fig 3: MNIST dataset

3) IAM

The IAM is a handwritten database of English language. Data were solicited from 400 diverse writers who created 1,066 forms of English text containing a vocabulary of 82,227 words. Data consists of full English language sentences. The dataset was also used for writer identification. Researchers were able to successfully identify writer 98% of the time during experiments on IAM dateset

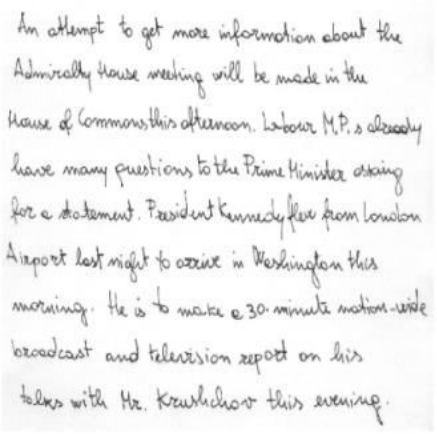

Fig 4: IAM dataset

4) CEDAR

This legacy dataset, CEDAR, was developed by the researchers at the University of Buffalo in 2002 and is considered among the first few large databases of handwritten characters. In CEDAR, the images were scanned at 300 dpi.

Fig 5: MNIST dataset

RESNET

Every prominent Neural network architecture uses innumerable layers to increase the accuracy and reduce the error rate, but with an increase in the number of layers, there is a common problem associated with deep learning referred to as Vanishing/Exploding gradient. This causes the gradient to become either 0 or too large. This leads to an increase in training and test error rates when the number of layers is increased To eradicate this problem, ResNet was proposed in 2015 by researchers at Microsoft Research introduced a new architecture called Residual Network.

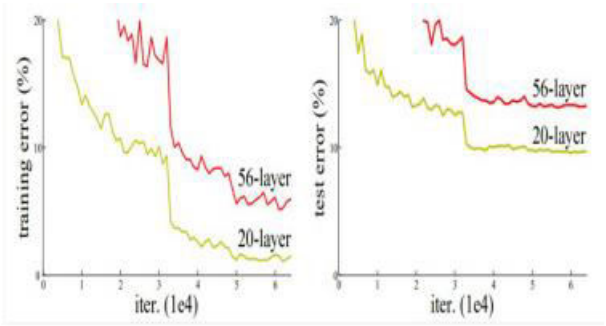

Fig 6: Training error (left) and test error (right) on with 20-layer and 56-layer "plain" networks. The deeper network has higher training error,

To solve the problem of the vanishing/exploding gradient, this architecture introduced the concept called Residual Network(ResNet). In this network, we use a method called skip connections. The skip connection skips training from a few layers and connects directly to the output . The approach behind this network is instead of layers learn the underlying mapping, we allow the network to fit the residual mapping. So, instead of say H(x), initial mapping, let the network fit,

F(x) = H(x) – x which gives H(x) = F(x) + x.

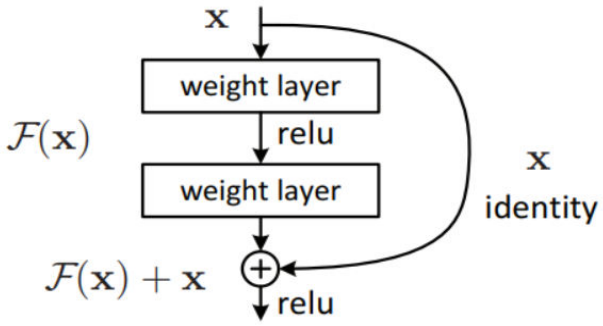

Fig 7: A Residual Block

The convenience of supplementing this type of skip connection is because if any layer hurts the performance of architecture then it will be skipped by regularization. So, this results in training a very deep neural network without the problems caused by vanishing/exploding gradient. There is a similar approach called highway networks, these networks also use skip connection. Similar to LSTM these skip connections also use parametric gates. These gates determine how much information passes through the skip connection. This architecture however has not provided accuracy better than ResNet architecture. Using the Tensorflow and Keras API, we can design ResNet architecture (including Residual Blocks) from scratch. Below is the implementation of different ResNet architecture. For this implementation we use CIFAR-10 dataset.

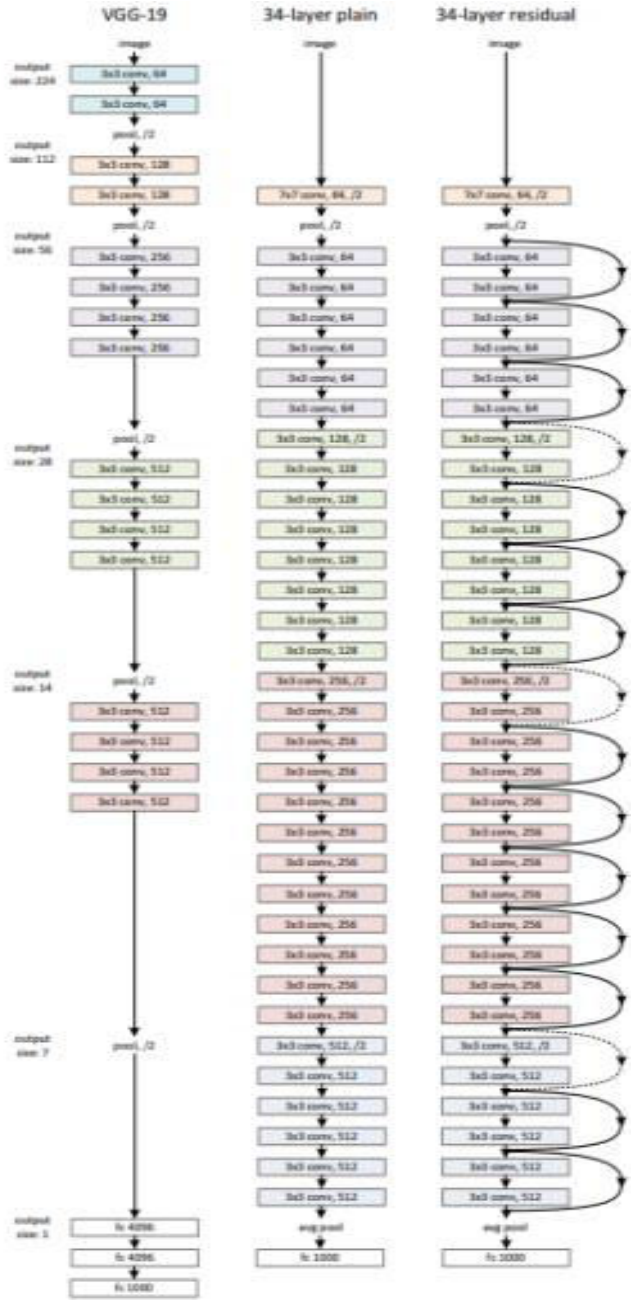

Fig 8: a residual network with 34 parameter layers

DEEP LEARNING

Deep learning is an instance of Artificial Intelligence or AI function that strives to simulate or mimic the working principle of a human brain for data processing and pattern formulation for decision making prospects. It is a subset of machine learning in an AI that owns or has networks that are capable of unsupervised learning from data that are unlabeled or unstructured. Deep learning can also be called deep neural learning or deep neural network. Deep Learning AI is capable of learning without human supervision, drawing from any kind of data. Being a subset of machine learning, deep learning utilizes artificial neural network of a hierarchical level to carry out the machine learning procedures or processes. With the help of deep learning, we can unravel a huge amount of data that is unstructured. For humans, that would take decades normally to understand and process it.

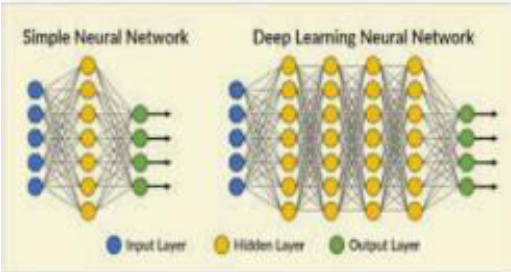

Fig 9: Difference between simple and deep learning neural network

ACCURACY

since no neural network can provide 100% accuracy there is always a margin to do better. the model used in this paper showed a variety of accuracy ranging 86% to 88% with different scripts from English, Hindi, etc. languages. The highest accuracy of 89% recorded was from the English language and 86% being lowest from the Hindi language.

FUTURE ASPECT

The main objective that should be considered for the future of this project is to increase the efficiency as well as the accuracy of the project. since both the constraints can never be achieved 100% this project carries a potential future in the following prospects with an increase in the datasets that are used by the model for its training can be proven vital in the process of increasing efficiency and accuracy of OCR Another prospect that needs to be kept in mind is the broad spectrum of linguistic scripts from different languages such as English, Hindi, Urdu, etc. shall be considered and the training sets for the same shall be deployed as the written text can be from any language greater the scripts covered broader will be the accuracy The last prospect that has potential work to be followed by in the future is to increase the layers in the residual neural network deployed for the refinement of features at the lowest layers .greater will be layering more refined will be the distinction in the features

CONCLUSION

With praiseworthy progressions in the field of technology, a lot of contributions have been bestowed to human society. with the same aim, this paper made a mere attempt to make some advancements in the E-policing methods not only increase transparency, accountability, and efficiency of the civic procedures and law and order but also create a better society for humanity The research is precisely contemplated to create a model which would recognize, synthesize and analyze the submitted F.I.Rs. and convert it into E-F.I.Rs. with utmost accuracy and efficiency

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BIOGRAPHIES

Pradyumn Misra is in 8th semester of his B. Tech program from S.R.M. Institute of Science and Technology Ghaziabad, India. This research paper is based on the Major Project to submitted in last semester. He is currently placed in Legato Inc.

Anurag Dingar is in 8th semester of his B. Tech program from S.R.M. Institute of Science and Technology Ghaziabad, India. This research paper is based on the Major Project to submitted in last semester. He is Currently placed in CTS corporation