SIGNATURE VERIFICATION SYSTEM

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Abstract- The objective is to develop a digital signature program for authentication and signing of documents for internal use of the organization. The signature will be verified by the help of training samples. The method used for training would be deep learning. It is part of machine learning which uses a neural network architecture. The scheme is based on the technique that applies preprocessing on the signature and extract features from it. These features are used next time for verification and prediction of genuine and forgery.

Keywords-Signature Verification; Deep Learning; Image processing layers

I. INTRODUCTION

Signature has been a distinguishing feature for a person's identification through ages. It plays a very important role in authentication of person's identity. There are various organizations such as banks, private institutions where matching of signature is considered to be important. Many documents like bank cheques and legal transactions require signature verification in order to be completed. The Bank's customers must write their signature, and bank's employees have to verify if the sample signature is the original signature in database, to complete any transaction required on that account. Moreover in many other organizations and defense agencies signature verification is important before issuing any command. Moreover, signature-based verification of a large number of documents is a very difficult and time consuming task. Signatures are a special case of handwriting in which special characters and flourishes are feasible. Signature verification is a different pattern recognition problem as no two genuine signatures of a person are precisely the same. Automatic signature verification system compete the current visual verification that depends mainly on the experience, mood and working environment of the verifier. Moreover, it is quite difficult for the eyes of any experts to precisely verify the ratios between lines and angles of a genuine signature to a fraud signature. There are two ways of signature verification: On-line and Off-line. On-line system uses a electronic device such as pad where as in off-line signature is scanned from paper.

II. METHODOLOGY

2.1.Deep Learning

Deep learning is a part of machine learning in which a model trains to perform classification tasks directly from images, text or sound. Deep learning is usually implemented with the help of a neural network architecture. The term "deep" generally refers to the number of hidden layers in the neural network. Traditional neural networks only contains 2 to 3 hidden layers, while deep networks can have as many as hidden layers as 150.

Deep learning models are trained by using a large sets of labeled data and neural network architectures that derive features directly from the data without the need for manual feature extraction.

A deep neural network combines various non-linear processing layers, using simple elements operating in parallel. It is inspired by the human biological nervous system, and consists of an input layer, several hidden layers, and a output layer. The layers are interconnected via nodes, or neurons, with each hidden layer that uses the output of the previous layer as its input.

2.2.Convolutional Neural Network

They are made up of neurons. The neurons have learnable weights and biases. Each neuron receives some inputs, it performs a dot product and optionally follows it with a non-linearity. The whole network still denotes a single differentiable score function: from the raw image pixels on one end to class scores at the other end. ConvNet architectures makes an assumption that the inputs are images, which allows us to encode certain properties into the architecture.

2.2.1.Image Processing Layer

The image processing layer is an optional layer of predefined filters that are kept fixed during training of neural network. The additional information besides the raw input image can also be provided to the network, such as edges and gradients .

2.2.2. Convolution Layer

Convolution is the first layer which is used to extract features from an input image. Convolution preserves the relationship of pixels by learning image features using small squares(fraction) of input data. It is a mathematical operation that generally takes two inputs such as image matrix and a filter or kernel.

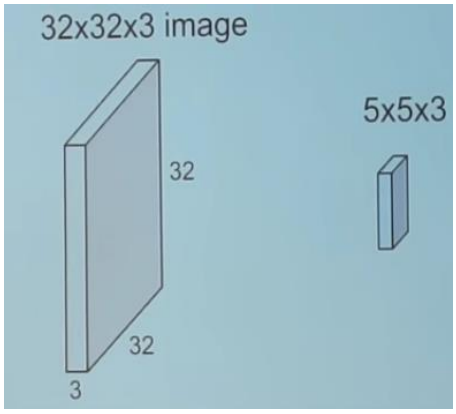

Fig 1. Convolving image with filter

2.2.3. Pooling Layer

Pooling layers section is used reduce the number of parameters when the images are too large. Spatial pooling also known as subsampling or downsampling which reduces the dimensionality of each map but retains any important information.

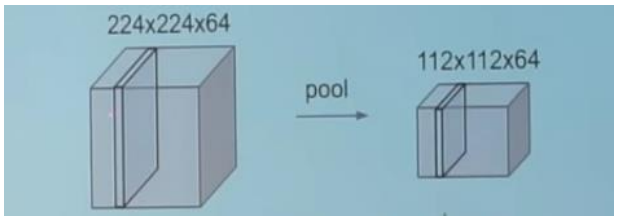

Fig 2. Pooling

Spatial pooling can be of different types:

- Max Pooling
- Average Pooling
- Sum Pooling

Max pooling takes the largest (max) element from the rectified feature map. The average pooling could also take the largest element while the sum of all elements in the feature map is called as sum pooling.

2.2.4. Classification Layer

Kernel sizes of convolutional filters and max-pooling rectangles as well as the skipping factors are chosen such that either the output maps of the last convolutional layer are downsampled to 1 pixel per map, or a fully connected layer that combines the outputs of the topmost convolutional layer into a 1D feature vector. The top layer is always fully connected, with one output unit per class label.

III. PROPOSED MODEL

The overall architecture of our signature recognition system follows: Acquisition, Preprocessing Feature extraction, and then Classification. Offline signatures are made on papers. This requires specifying the resolution, image type and format to be used in scanning each image. So in any offline signature verification system, the first step is to extract these signatures from papers but since the signature datasets are taken from internet. Thus, this stage is ignored. Features available to extract in offline signatures are either global features or texture feature i.e. features extracted from whole images. In this, the features extracted are Aspect ratio, Signature Area, Maximum horizontal And Maximum vertical histogram, End point number of the signature, texture Homogeneity, Texture contrast, Entropy. These extracted features from the basis to compare and there by classify Signatures either genuine or forge. The features extracted from database are compared with the features extracted from test signatures and based on the classification criteria the signatures are classified either genuine or forged.

3.1. Libraries

The libraries which are used to implement deep learning are tensor flow and keras.

3.1.1. Tensorflow

It is an open-source software library used for dataflow programming across a range of tasks. It is a symbolic math library which is also used for machine learning implementations such as neural networks. Nowadays, hardwares specially designed for training for the purpose with Cloud TPUs. The T is for tensor.

Fig 3. Tensor Processing Unit

3.1.2. Keras

It is an open source deep learning library. It is designed for fast implementation of deep learning neural network. It runs on Python versions between 2.7 and 3.5 and can seamlessly execute on GPUs and CPUs given the underlying frameworks. It was build using following guiding principles.

- Modularity
- Minimalism
- Extensibility

IV. PREPROCESSING

Preprocessing plays an important role in signature verification. Signature images may present variations in terms such as pen thickness, scale, rotation, etc., even among authentic signatures of a person. Bellow we summarize the main preprocessing techniques:

Signature extraction - This is an initial step that consists of finding and extracting a signature from a document. This is a particular problem in bank cheques, where the signature is often written on top of a complex background. This step is, however, not considered in the signature verification study, as it already consider signatures extracted from the document.

Noise Removal - Scanned signature image often contains various noise. A strategy to address this problem is to apply a noise removal filters to the image, such a median filter. It is common to apply morphological operations to fill small holes and remove small regions of connected components .

Size normalization and centering - Depending on the properties of the features to be used, various size normalization strategies are adopted. The simplest strategy is to crop the signature images to have a tight box on the signature. Other strategy is that authors use a fixed frame size (width and height), and center the signature in this frame.

Signature representation - Besides just using the gray level image as input to the feature extractors, other representations have to be considered.

Signature Alignment – alignment is a common strategy in online signature verification, but not broadly applied for the offline signature verification.

V. FEATURES EXTRACTION

It is an important step in developing any signature verification system since it is the key to identifying and differentiating a user's signature from another. The features extracted is based on shape and texture of an image. The features are global features and texture features. While global features provides information about specific cases concerning the structure of the signature, texture features are intended to provide overall signature appearance information.

VI. DATASETS

A data set (or dataset) is collection of various data. Mostly a data set corresponds to the contents of a single database table, or a single statistical data matrix. Every column of the table represents a particular variable, and each row corresponds to a given member of data set.

Various signature datasets are available on many deep leaning websites. Our data is taken from one of these websites .

The system would be trained with the help of these datasets. After training when next time a signature is scanned from these datasets the system would now compare it to the dataset.

An advantage of importing data sets is that it would reduce the complexity of preparing it and verifying it on all grounds. The datasets consists of 1504 images belonging to 2 classes:

- Genuine Signature
- Forge Signatures

VII. RESULT

The proposed model has a accuracy of 95% (approximately). The accuracy and loss curves are as given below:

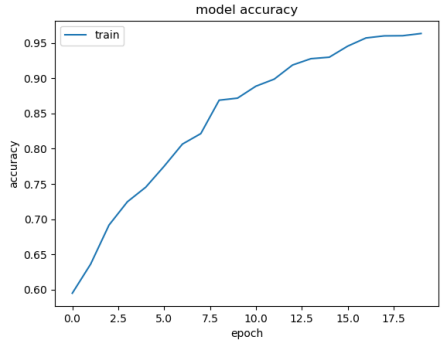

Fig 4. The accuracy curve of model

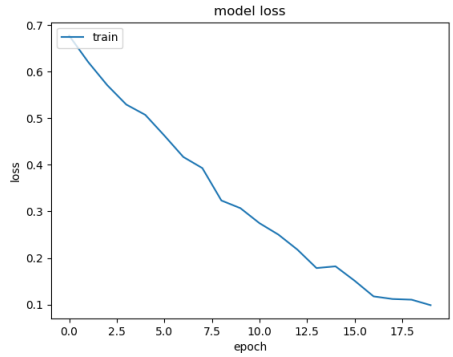

Fig 5. loss curve of the model

The model accurately predicted the signature as forge when a signature was tested in the model.

VIII. CONCLUSION

A reliable signature verification system is an important part of law enforcement, security control and many business processes. It can be used in many applications like cheques, certificates, contracts etc. The concept used for training the system is deep learning. Deep learning is the concept using neural network architecture. The data samples are imported from the internet. The system showed promising results.

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