Digital Signature Verification Using Artificial Neural Networks


ABSTRACT--- Identification and verification of hard written signature from images is major issue. This is very difficult as even human eye does not have that much visual ability to identify every detail of the in handwritten. Signature changes every time so it is difficult for humans to identify the original and forged ones. By using deep learning which uses the sophisticated is digital configured replica of human brain, we can identify the forgery done in signature with higher accuracy.

Index Terms — deep learning, digital configured replica, forgery, signature

I. INTRODUCTION

The robustness of human brain has always been an enigma and this has caused people to replicate it digitally. The human eye has a great efficiency of recognition due its architecture. This inspiration has led to people constructing artificial neural network and so deep learning.

In this we generally are going to assess the ways a human being would give his signature using some deep learning algorithms and artificial neural networks by which we can train the system accordingly and verify if the signature is real or forged. It would be a great way to authenticate the signatures and verify them accordingly. It would be a better option to verify the signatures using this model rather than visual recognition through human eye which have a high chances of making a mistake.

II. SIGNATURE VERIFICATION

2.1 Offline Signature Verification:

Verification of signatures with features which are already present is called as offline signature verification. The features are very simple and basic and the image scanned through a camera should follow certain methods for verification. Design of these kind of systems is difficult as there will be less features available.

2.2 Nature of Human Signature:

Human signatures are generally generated by the inbuilt functions of the human neuromuscular area which induces rapid movements. This system will largely consist of neurons and muscle and fibers which make us know that the velocity of the hand produces the equation. So signatures for every person are unique. In this model we can assess the person who will give the signature and train our model accordingly.

2.3 Types of Forgeries:

Forgeries of signatures are classified into three types as mentioned below and we will solve and try to prevent all this forgeries in our model.

2.3.1 Random forgery:

A signature which is forged and it may be the genuine signature of other person.

2.3.2 Casual Forgery:

A signature forgery in which the one who is doing the forgery will know the name of the victim

2.3.3 Skilled Forgery:

As the name suggests a person who is skilled professional is forging signatures is involved in forging the signatures.

III. NEURAL NETWORK OUTLINE:

A system which does computing and is combines with basic, and highly coincidental processing elements which use the data to get a highly relevant and faster response from the inputs taken. Artificial neural network models are a subpart of the machine learning models which are motivated by the functioning of the brain. Neural networks generally work like the neurons of the brain and the connected neurons will work in a network process to collect and process the data for providing the necessary output. There will be an input layer to the system which consists of all the patterns in which the system should process and also the necessary inputs and it communicates with the hidden layer as shown in the below figure and the hidden layers use the patterns and inputs by the input layer and are used to find out a relevant function for the task to be performed and then they communicate with the output layers to display the final output.

Feedforward mechanism:

This mechanism does not form circles like many artificial neural networks. This mechanism goes in a single way from the input to the hidden layers to the output and do not form any loops or circles in the process.
IV. PROPOSED METHODOLOGY:

In our proposed method we will construct a neural network by optimizing some existing neural networks and it will have a use the data structure tree along with nodes similar to human eye which has neurons and it used for recognition of patterns. There are several steps involved in our method and it goes as following.

V. IMPLEMENTATION

5.1 Pre-processing:

In image processing application, pre-processing is required to remove discrepancies, from the input image. Signatures are changed to greyscale, using following equation as:

\[ \text{Grey color} = (0.114 \times \text{Blue}) + (0.299 \times \text{Red}) + (0.587 \times \text{Green}) \]

The important factor in preprocessing stage is to build standard signature which is prepared for extraction of features. The pre-processing stage includes:

5.1.1 Image scaling:

Let H = input image height & W = input image width. The image can be fit to 100*100 pixels by applying the equations:

\[ \text{Xnew} = (\text{Xold} \times 100)/\text{W}; \]
\[ \text{Ynew} = (\text{Yold} \times 100)/\text{H}; \]

Xnew is calculated X coordinate and Xold is the original X coordinate
Ynew is calculated Y coordinate and Yold is the original Y coordinate

With the above equations, the image is scaled to a uniform 100*100 pixels image.

5.1.2 Normalization of signature:

It is possible that signature can be fractured due to imperfections in image scanning and capturing. It is also possible that the dimensions of signature can vary from person to person and even the same person can sometimes have different sizes based on the mood and environmental factors. So a process is required to overcome the size variation problem and achieve a standard signature size for all signatures.

We also need to preserve the characteristic ratio between height and width of a signature.

After performing the normalization process, all the signatures will have the similar dimension. Normalization process is done based on the below equations

\[ Y_{\text{new}} = [(Y_{\text{old}} - \text{Ymin})/(\text{Ymax} - \text{Ymin})] \times M \]
\[ X_{\text{new}} = [(X_{\text{old}} - \text{Xmin})/(\text{Xmax} - \text{Xmin})] \times M \]

Xold and Yold are coordinates for original input signature, Xnew and Ynew are coordinates for normalized signature, M = Width or height meant to the normalized signature

5.1.3 Thinning:

It is possible that the signature is written on different pen and the thickness thus varies from one pen to another. The purpose of thinning is to eliminate thickness differences in signature by making all of them one pixel thick. Thinning is used to enhance the object’s global properties and to transform the input image into a compact form.

5.2 Feature Extraction:

This method is used for extracting the necessary and essential features from the input image. A feature vector is created from the features extracted. Each signature has a unique feature vector. These features are extracted as follows

The feature extraction module uses moment invariants to extract texture features of the image using central moment and derived invariant moment. The central moment, \( \mu \), with respect to the centroid, and the normalized central moment, are calculated as:

\[ m_{pq} = \sum_{x} \sum_{y} (x-x')^p (y-y')^q \alpha_{xy} \]
\[ n_{pq} = \frac{m_{pq}}{(\mu_{oo})^{\frac{p+q}{2}}} \]

where, \( \lambda = \frac{(p+q)}{2} + 1, (p+q) > 2 \)
5.3 Neural network training:

The features extracted are fed to natural network as inputs. Before that the networks are trained with data sets. Each neural network has a corresponding user to it. So a user has two neural networks one with feedforward mechanism and the other with feedback mechanism. The user’s features are given as input to both the neural networks and the output is recorded.

VI. FEEDFORWARD MECHANISM

ALGORITHM:

```plaintext
// initialization
feature extraction(input, user)
input = [signature features]

// forward pass
for each layer in network do
  activation = sigmoid(input * weight + bias)
  input = activation
end

// output
output = {1 if real signature, 0 if forged}
```

VI. OUTPUT EXPLANATION:

The output for this model will be 1 if the signature is real and will be 0 if the image is forged.
VIII. RESULT AND PERFORMANCE:

8.1 ROC GRAPH:

8.1.1 ROC GRAPH FROM TRAINING

![ROC Graph from Training](image1)

8.1.2 ROC PLOT AFTER TESTING

![ROC Plot After Testing](image2)

8.2 INFERNECE FROM THE GRAPH

As we can see that the graph we can intervene that there is high possibility in getting accurate value.

8.3 CONFUSION MATRIX:

8.3.1 Confusion matrix – training:

![Confusion Matrix - Training](image3)

8.3.2 Confusion Matrix from testing:

![Confusion Matrix - Testing](image4)

8.3.3 Interpretation:

As we can observe the in testing matrix the possibility is distributed 50% equally is sign that the neural network works efficiently.

IX. OTHER GRAPHS:

![Other Graphs](image5)
X. WORK PLACE IMAGES:
REFERENCES:


