The Affect of Fuzzification on Back propagation Static Signature Recognition

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Abstract_ In our paper research, Improve the Recognition rate of the off-line (static) Signature. By building an intelligent system has much ability to distinguish between the original signature and the fake signature. Where it will be to use one of the most important areas of AI is Neural Networks. ANN used in our research this is the Feed-forward Neural networks (Back propagation). To improve performance and eliminate the overlap in the professionalism of the fake signature of the tradition will be used Fuzzy set (membership). By using Fuzzy set will each value have the five values that we will get rid of ambiguity or converged data. ANN was trained on Fuzzied data after than test the intelligent system by novel signature the rate of recognition (98%). We have thus been improved rate of detection or recognition of any system is through this system intelligent.

Key words: Recognition Signature, Artificial Neural Networks, Fuzzy, off-line Signature.

I. INTRODUCTION

The increasing of computers in the world and internet become more available and cheap in same time the intruder or hacker has become more effective and novel. This evolution in the intrusion is our concern about the protection and confidentiality of the information for access by unauthorized persons. This is the main motivation of our research through the development of the existing protection systems. According to statistics most people who use personal signature as proof that this thing is a sign indicating the owner, that's why a lot of the attackers took advantage of this property in common use through imitation or forgery signature of the person and thereby achieve the goal. Objectives of the Intruder of attacker is like stealing information, access to data not authorized or tamper with them in the data through change or modify. Our work is obtained in application of the Biometric. Biometrics (or biometric authentication) refers to the identification of humans by their characteristics or traits [8]. Computer science, biometrics to be specific, is used as a form of identification and access control [9]. There are two types of signatures, namely Off-line or static signatures are scanned from paper documents. Off-line signature analysis can be carried out with a scanned image of the signature using a standard camera or scanner. On-line or dynamic signatures are written with an electronically instrumented device and the dynamic information (pen tip location through time) is usually available at high resolution, even when the pen is not in contact with the paper [1]. Applications of Artificial Intelligent enter in many fields of the life; consider the neural networks one of the best fields of AI. The ANN uses in the research the Back propagation. The figure (1) demonstrates basic structure of signature recognition systems:
II. BIOMETRIC SYSTEM

A biometric system is fundamentally a pattern-recognition system that recognizes an individual based on an attribute vector derived from a specific physiological or behavioral characteristic that the person possesses [13]. That feature vector is frequently stored in a database (or recorded on a smart card given to the individual) after being extracted. A biometric system based on physiological characteristics is normally more reliable than one which adopts behavioral characteristics, even if the last may be easier to integrate within certain specific application. Biometric system can than run in two modes: verification or identification. While recognition involves comparing the acquired biometric information against templates corresponding to all users in the database, verification involves comparison with only those templates corresponding to the claimed identity. This implies that identification and verification are two problems that should be dealt with separately.

A simple biometric system consists of four basic components [14,15]:

- Sensor module which acquires the biometric data.
- Feature extraction module where the acquire data is processed to extract feature vectors.
- Matching module where attribute vectors are compared against those in the template.
- Decision-making module in which the user's identity is established or a claimed identity is accepted or rejected.

Any human physiological or behavioural trait can serve as a biometric characteristic as long as it satisfies the following requirements [16]:

- Universality: Everyone should have it.
- Distinctiveness: No two should be the same.
- Permanence. It should be invariant over a given era of time.
- Collectability: In real-life applications, three extra factors should also be considered: performance (accuracy, speed, resource requirements), acceptability (it must be harmless to users), and circumvention (it should be robust enough to various fraudulent methods).

The main types of the Biometric systems: Fingerprint, Iris, Retina, Hand, Palm vein, Face [10].

III. RELATED WORK

In recent years, there is more interest in recognition of the Signature including Off-line or static signatures and below some of these researches:

Elizabeth I. Maduko, present in the research paper Pattern recognition is the classification of data into predetermined categories, usually using statistical methods. Gait recognition is an area of application of pattern recognition because it classifies and identifies an individual by their gait signatures [2].

O.C Abikoye and et al. In this study, we presented Off-Line Signature Recognition and Verification System which is based on image processing, moment invariants, some global properties and neural networks. Both systems used a three-step process; in the first step, the signature is separated from its image background. Second step performs
normalization and digitization of the original signature. Moment invariants and some global properties which are used as input features for the neural network (NN) are obtained in the third step [3].

Debnath bhattacharyya and et al., In this paper, we implement the basic algorithm of artificial neural network through Back-propagation algorithm. Here we use three (Input, output and hidden) layer, six node (three in input layer, two in hidden layer and one in output layer; because number of nodes in first hidden layer is always less than or equal to number of input layer nodes and number of nodes in last hidden layer is always greater than or equal to number of nodes in output layer), number of iteration of each pixel is 39000 times. In this paper we solve this problem through artificial neural network [4].

Mohammed A. Abdala and et al., In this paper, a problem for Offline Signature Recognition and Verification is presented. A system is designed based on two neural networks classifier and three powerful features (global, texture and grid features). Our designed system consist of three stages: the first is preprocessing stage, second is feature extraction stage and the last is neural network (classifiers) stage which consists of two classifiers, the first classifier consists of three Back Propagation Neural Network and the second classifier consists of two Radial Basis Function Neural Network [5].

Khattab M. Ali and et al., in this paper present how use the artificial intelligent i.e. Neural Network (Back propagation) with actual data and fuzzyfy data. Explain how type the data affect to the accuracy of the detection or classification. Use in this paper fuzzy set (member ship) but not use the fuzzy logic (rules) [6].

Adrian Perrig, introduces the BiBa signature scheme. BiBa signature scheme is a new signature construction that uses one-way functions without trapdoors. The most important features of BiBa signature scheme is a low verification overhead and a relatively small signature size. In comparison to other one-way function based signature schemes, BiBa has smaller signatures and is at least twice as fast to verify (which probably makes it one of the fastest signature scheme to date for verification). BiBa stands for Bins and Balls signature a collision of balls under a hash function in bins forms the signature [7].

IV. ARTIFICIAL NEURAL NETWORK

The idea of Artificial Neural Network (ANN) came from the idea of working human brain; the first step toward artificial neural networks came in 1943 when Warren McCulloch, a neurophysiologist, and a young mathematician, Walter Pitts, wrote a paper on how neurons might work. Think scientists in a way which can simulate the process, which occur in the human mind, and came to the knowledge of Neural Network, which falls under science artificial intelligence, so as to make computers intelligent devices, they can gain knowledge of the same way that acquires the rights of knowledge, they control the way weights during the learning. In addition, on the structural side large number of highly interconnected processing elements (neurons) working together. The neuron is the basic information processing unit of a Neural Network (NN); it consists of: A set of links, describing the neuron inputs, with weights W1, W2, ...Wm, An adder function (linear combiner) for computing the weighted sum of the inputs (real numbers) [11]

\[ U_j = \sum_{i=1}^{p} W_{ji} x_i \quad \text{...... (1)} \]

And an activation function (squashing function) for limiting the amplitude of the neuron output.

Tan-Sigmoid function=\( 2/(1+\exp(-2\times n))-1 \) \quad \text{...... (2)}

A. Feed–forward Neural Network: Back propagation (BP):

Most popular training method for neural networks, the generalized delta rule [12], also known as back propagation algorithm. The explanation intended to give an outline of the process involved in Back propagation algorithm. The (NN) explained here contains three layers. These are input, hidden, and output layer.
During the training phase, the training data is fed into the input layer. The data is propagated to the hidden layer and then to the output layer. This is called the forward pass of the Backpropagation algorithm. In forward pass, each node in hidden layer gets input from all the nodes from input layer, which are multiplied with appropriate weights and then summed. The output of the hidden node is the nonlinear transformation of this resulting sum. Similarly each node in output layer gets input from all the nodes of the hidden layer, which are multiplied with appropriate weights and then summed. The output of this node is the non-linear transformation of the resulting sum. The output values of the output layer are compared with the target output values. The target output values are used to teach network. The error between actual output values and target output values is calculated and propagated back toward hidden layer. This is called the backward pass of the Backpropagation algorithm.

V. FUZZY MEMBERSHIP

In fuzzy sets define the linguistic notions, and membership functions define the truth-value of such linguistic expression [18]. The membership degree to a fuzzy set of an object defines a function where the universe of discourse (set of values that the object can take) is domain, and the interval [0,1] is the range. That function is called the membership function. Figure (2) shows the used membership function, the triangular membership function which is illustrated in equation (3). A collection of fuzzy sets, called fuzzy space, define the fuzzy linguistic values or fuzzy classes that an object can belong to.

\[
f(x,a,b,c) = \begin{cases} 
0, & x \leq a \\
 x-a, & a \leq x \leq b \\
 b-a, & b \leq x \leq c \\
 c-b, & c \leq x \\
0, & \end{cases} \quad (3)
\]

With fuzzy spaces, fuzzy logic allows an object to belong to different classes at the same time. This concept is helpful when the difference between classes is no well define.

For example, assume that a, b, c of each set of the five sets (L, ML, M, MH, and H) are:

L: \( a = 0, \quad b = 0.166, \quad c = 0.333 \)

ML: \( a = 0.166, \quad b = 0.333, \quad c = 0.5 \)

M: \( a = 0.333, \quad b = 0.5, \quad c = 0.666 \)

MH: \( a = 0.5, \quad b = 0.666, \quad c = 0.833 \)

H: \( a = 0.666, \quad b = 0.833, \quad c = 1 \)

Let \( X = 0.2 \) using equation (3), its membership degree for:

\[
\text{L} = 0.7964 \\
\text{ML} = 0.2036 \\
\text{M} = 0 \\
\text{MH} = 0 \\
\text{H} = 0
\]

In the above example shows when (0.2) enter to the Fuzzy membership become have five values (0.7964, 0.2036, 0, 0, 0).

VI. IMPLEMENTED INTELLEGENT RECOGNITION SYSTEM:

In this work, recognition system is implemented via ANN with fuzzyfied data. This system consists of the following components as illustrated in figure (3):
Step 1: Preprocessing & Signature capturing: this process includes revises processing in which the image must be adequate to be adaptive to the next step. Then the Signature is truncated and resizing from the original image.

Step 2: Converting image into gray scale: this process deals with the converting of color image into gray scale image.

Step 3: Edge detection: this process is useful to generate the minimum feature required to identify the specific iris.

Step 4: Features that have been generated from the previous stage is converted to a digital matrix and equivalent values to the fuzzy set (membership).

Step 5: Training neural networks using the data obtained from the previous step.

Step 6: Test the ANN and determine the accuracy, the verification of the signature.

Figure (3) shows components of the intelligent system

VII. Results and Analysis
The implemented recognition system is tested via different types of images signatures. This section tries to visualize the implemented results to ensure the effect of each step.

Figure (4) Capturing the original image

Figure (5) Histogram of the gray image

Step 1: Pre-processing & Signature capturing

This step is applied to the original image in which the image is filtering and capturing to specify the boundaries of Signature image. Preprocessing step is performed to minimize noise as possible as well as to resizing the original image as shown in figure (4). And figure (5) shows the histogram of the original Image.

Figure (6) canny method as shown in figure (6)
Figure (6) shows canny method

Step 4: Features: generate digital matrix and equivalent values to the fuzzy set (membership). Figure (7) shows the matrix:

```
3.0110.000000001.0111.0
02.1101.001113.0101.0
21.10111.0010111.0101.0
21.1010011.0010111.0101.0
21.101111.0010111.0101.0
001.001110.1110111.0
011.010111.0110111.0
0011.111111.0011111.0
11.111111.0010111.0
0011.111111.0011111.0
11.000000.000000000
```

Figure (7) digital matrix

Step 5: Training neural networks using the fuzzyfied data. The figure (8) demonstrates of the stricter ANN. The rate of training ANN is (99 %). Figure (9-a) shows the performance of train data and figure (9-b) shows the rest of parameter ANN:

![Structure ANN](image)

Figure (8) shows the structure ANN

Figure (9 - a) shows the Performance

![Graph](image)

Figure (9 - b) shows the Parameter

Step 6: Test the ANN: after the training ANN is tested, the ration test is (98 %).

VII. CONCLUSION

In our paper research, we improved off-line signature recognition via use one of the most important applications of Artificial Intelligent is Neural Network (Back Propagation). To improve its performance use Fuzzy set (Membership). After the pre-process the signature, the ANN is trained and then tested with the ration of the test is (98 %). Thus we get rid of the weaknesses of off-line signature biometric systems personal may not constantly sign in a consistent style. And through the construction of an Intelligent system has the ability to diagnosis between this original signature or fake.
REFERENCES

[1]. DR. Marinw Gavrilova,” Signature Recognition”.

[2]. Elizabeth I. Maduko,” PATTERN RECOGNITION OF HUMAN GAIT SIGNATURES”.


[8]. As Jain & Ross (2008, footnote 4 on page 1) point out, ”the term biometric authentication is perhaps more appropriate than biometrics since the latter has been historically used in the field of statistics to refer to the analysis of biological (particularly medical) data [36]” (wikilink added to original quote).


Khattab M. Ali was born in Anbar-Iraq at 1978. He received his B.Sc. from Al_M’ammon college university at 2000, Baghdad, Iraq. He received MSc. degree from CS Department in Al-Bayt University, Jordan 2008. He joined in 5 January 2005 Computer Sciences Department, Almaref College University, Al-Anbar, Iraq. Since 2009 till now he joined as Assistant Instructor at the college of computer, Information System Department, Al-Anbar University, Iraq.
والتي تسبب لنا الغموض في عملية التميز. والشبكات العصبية سيتم تدريبيها ببيانات مضربة وبعدها يتم اختبارها وهذا نكون قد حصلنا على نظام ذكي يستطيع تميز التواقيع التي لم يتدريب عليها من قبل وكانت نتيجة كفاءة الموديل هي (98%). وبهذا نكون قد قمنا بتسحسن معدل التميز والاكتشاف لاي نظام من خلال استخدام نظامنا الذكي.