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Character Recognition by Levenberg-Marquardt (L-M) Algorithm Using Back Propagation ANN

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***Abstract*—** The Author dedicatedly emphasis the character recognition that is applied vigorously on various techniques and the comparison of analysis has been done to justify the Network. Basis of complexity of task the network algorithm has been designed and developed and the recognition pattern is trained. The character recognition sequenced has been ranged on characters data and available technique. The emphasis has been given on the comparison and to increase the recognition accuracy and decreasing the recognition time. The character recognition interface includes the recognition of defined characters made available in the database and the integration of it. character recognition system is implemented for the characterisation of English alphabets with customised specific requirements using most contemporary optimisation algorithms (Levenberg-Marquardt) in back-propagation Multi layered Feed -forward network in Artificial Neural Network. The ANN training pattern has been done with most accuracy to the Characters from (A-J) are created with size of each character is n x n square matrix form.

Keywords- *Character recognition, Artificial Neural Network, Multi layered Feed -forward network, back-propagation, Levenberg-Marquardt Algorithms.*

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I. INTRODUCTION

The Character Recognition has been the one of the most significant application in the development area of Artificial Neural Network field in the arena of Artificial Intelligence. It is a process of automatic computer recognition and identification of characters in which a scanned and digitized character image is converted into machine-editable format. Classical methods in pattern recognition were not sufficient for recognition of text characters due to varying shape, size and style of characters. So, intelligent systems are designed which are capable of recognizing characters of changing fonts. But still it is the case of less efficiency and accuracy.

Character recognition is an important topic in pattern recognition which is the backbone of machine perception. The objective of character recognition is to translate human readable characters to machine readable codes. Character recognition has been applied to various areas such as automatic postal address readers, automations and automatic data entry from paper documents to computers.

II. ARTIFICIAL NEURAL NETWORK

Artificial Neural Network (ANN) are a kind of soft computing tools that help us recognizing patterns besides allowing us to accomplish a lot of other tasks. The essential idea of learning by an ANN is borrowed from the neural learning system of human being. The recognition capability of human being is due to the potential of nerve cells to store and propagate information. Keen observation over the biological neuro system enables us with the insight of the learning process. This knowledge has been applied in the design of ANN that works in a manner similar to the biological system. It is not that the ANN must resemble the above said biological system, but the major learning steps can be reliably imitated.

Mathematical model of ANN-

A very simple mathematical model of a neuron was first presented by McCulloch and Pitts. In their model, there are n input nodes I_1, I_2, I_3.....I_n, and one output node O. The operation of the neuron is as follows:

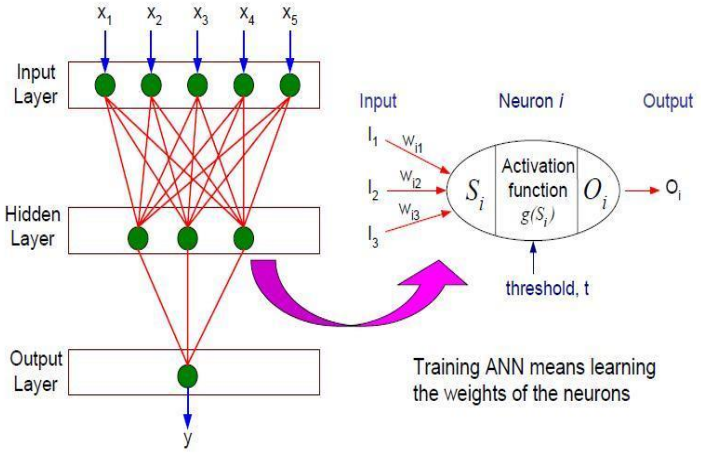


Figure **1:** Mathematical Model of ANN

$$O_i = f\left(\sum W_{ij} I_j\right)$$

Each of these inputs is multiplied by a connection weight. The weights are represented by w (n). These products are summed, fed to a transfer function (activation function) to generate a result, and this result is sent as output. This is also possible with other network structures, which used different threshold functions as well as different transfer function.

A.

B. Type of Artificial Neural Network-

a) Single-Layer Feed-Forward
b) Multi-Layer Feed-Forward
c) Recurrent
d) Self-Organizing Map (SOM)
e) BRANN
f) Back-Propagation
g) Hopfield Network
h) Radial Basis Function.

III. BACK PROPAGATION NETWORK

The Back propagation Network is an widely accepted, specific tool that generalised and optimised the performance of real time system under the hood of multilayer network and non linear function. By using different set of step it is defined using specific rules and algorithms and the result is compared for nonlinear networks. These techniques classify & predict the network and to solve the wide ranging of problem basis of real time performance that has to be optimised for online and offline mode that could be beneficial. A successful character recognition methodology depends heavily on the choice of the alphabets used by the pattern classifier. The back-propagation is widely used learning algorithm in training multilayer perceptrons (MLP). the MLP refer to the network consisting of a set of sensory units (source nodes) that constitute one input layer, one or more than one hidden layers of computation nodes , and one output layer of computation nodes .the input signal propagates through the network in a forward direction , from left to right and on a layer –by –layer basis.

IV. LLEVENBERG-MARQUARDT(L-M) ALGORITHM -

It is the most sophisticated, widely used optimal and fastest algorithm although it takes large amount of Memory. this method is a second order approach and for training speed without having to compute the Hessian Matrix. it is safe and fast algorithm as compare to other algorithm ,but it was found that the efficiency of the method decreases as the number of weight increases as the size of the Hessian increases and requires a large capacity memory.

Levenberg-Marquardt Algorithm -

Input: $R^n \rightarrow R$ a function such that

f (i)=

Output: t, o local minimum of the cost function f

Begin

$k \leftarrow 0$

$w \leftarrow w_0$

whileupdate < > 0 and $k < k_{max}$ **do**

findd such that $([H+l.I]^{-1} . \tilde{N}J).d = J^T * f$

$W \leftarrow W_{lm}$

If $f(W_{lm}) < f(W)$ **then**

$W = W_{lm}$

$l \leftarrow l/v$

Else

$l \leftarrow vl$ **Return W end**

V. MYTHOLOGY

The application of L-M to neural network training is described this algorithm appears to be the fastest method for training moderate-sized feed-forward neural networks (up to several 1000 weight). It also has an efficient implementation in MATLAB software.

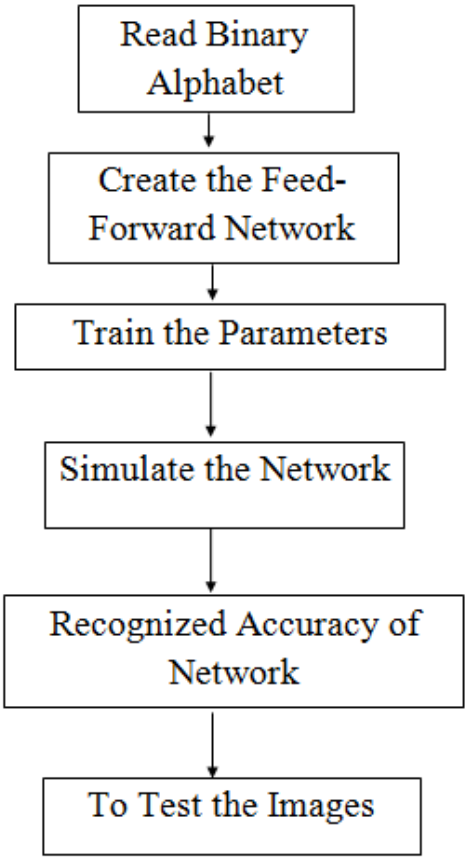
Step1-The code creates training all the input vectors are placed in one matrix.

Step2 - Create the feed-forward network.

Step3- You might want to modify some of the default training parameters. If you want to use the default training parameters, the preceding commands are not necessary.

Step4- Now you are ready to train the network.

Step5- Simulate the trained network to obtain its response to the inputs in the training set.



Flow chart 1

VI. RESULT

This chapter discusses the use of artificial neural network for the purpose of character recognition. Characters from (A-J) are created with size of each character is 6 x 6. The matrix are represented as

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$$A=\begin{bmatrix}0&0&0&1&0&0\\0&0&1&0&1&0\\0&1&0&0&0&1\\0&1&1&1&1&1\\0&1&0&0&0&1\\0&1&0&0&0&1\end{bmatrix} \quad B=\begin{bmatrix}1&1&1&1&1&0\\1&0&0&0&0&1\\1&1&1&1&1&0\\1&0&0&0&0&1\\1&0&0&0&0&1\\1&1&1&1&1&0\end{bmatrix}$$

$$C=\begin{bmatrix}1&1&1&1&1&1\\1&0&0&0&0&0\\1&0&0&0&0&0\\1&0&0&0&0&0\\1&0&0&0&0&0\\1&1&1&1&1&1\end{bmatrix} \quad D=\begin{bmatrix}1&1&1&1&0&0\\1&0&0&0&1&0\\1&0&0&0&0&1\\1&0&0&0&0&1\\1&0&0&0&1&0\\1&1&1&1&0&0\end{bmatrix}$$

$$E=\begin{bmatrix}1&1&1&1&0&0\\1&0&0&0&0&0\\1&1&1&1&1&1\\1&0&0&0&0&0\\1&0&0&0&0&0\\1&1&1&1&1&1\end{bmatrix} \quad F=\begin{bmatrix}1&1&1&1&1&1\\1&0&0&0&0&0\\1&1&1&1&1&1\\1&0&0&0&0&0\\1&0&0&0&0&0\\1&0&0&0&0&0\end{bmatrix}$$

$$G=\begin{bmatrix}1&1&1&1&1&1\\1&0&0&0&0&0\\1&0&0&0&0&0\\1&0&1&1&1&1\\1&0&0&0&0&1\\1&1&1&1&1&0\end{bmatrix} \quad H=\begin{bmatrix}1&0&0&0&0&1\\1&0&0&0&0&1\\1&0&0&0&0&1\\1&1&1&1&1&1\\1&0&0&0&0&1\\1&0&0&0&0&1\end{bmatrix}$$

$$I=\begin{bmatrix}1&1&1&1&1&1\\0&0&0&1&0&0\\0&0&0&1&0&0\\0&0&0&1&0&0\\0&0&0&1&0&0\\1&1&1&1&1&1\end{bmatrix} \quad J=\begin{bmatrix}1&1&1&1&1&1\\0&0&0&1&0&0\\0&0&0&1&0&0\\1&0&0&1&0&0\\1&0&0&1&0&0\\0&1&1&0&0&0\end{bmatrix}$$

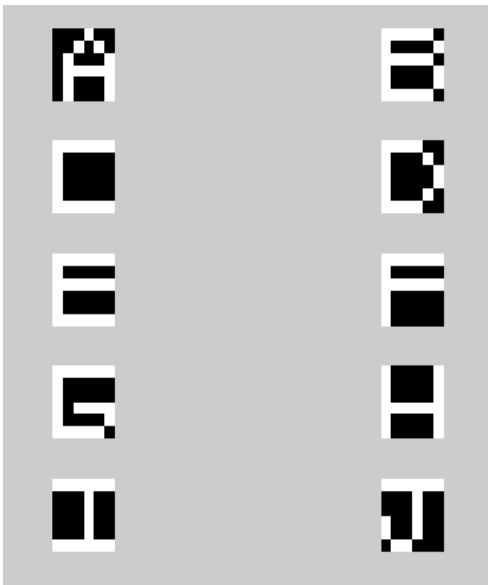

Figure 2: Characters for training (A-J)

For character recognition following neural network topology is used

1. Multi –layered feed forward architecture.
2. Recurrent neural network.

Multi layered feed forward architecture

In multi-layered feed forward architecture, the following training algorithms are used

1. Levenberg-Marquardt
2. Gradient descent

Table 1: ANN Parameter for Levenberg-Marquardt Learning Rule

S.No	ANN Architecture	Multi-layered feed-forward
1.	Maximum iteration	1000
2.	Learning rate	0.01
3.	Training goal	0.001
4.	Activation function	sigmoidal function and linear function
5.	Number of input neurons	10
6.	Number of hidden layer	1
7.	Number of neurons in hidden layer	40
8.	Error criteria	MSE
9.	Training Algorithm	Levenberg- Marquardt
10.	Number of output neurons	10

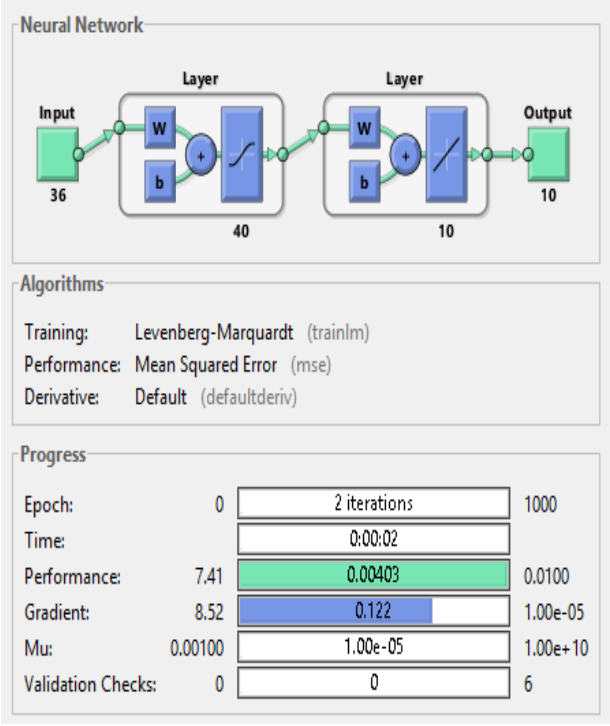

Figure 3:

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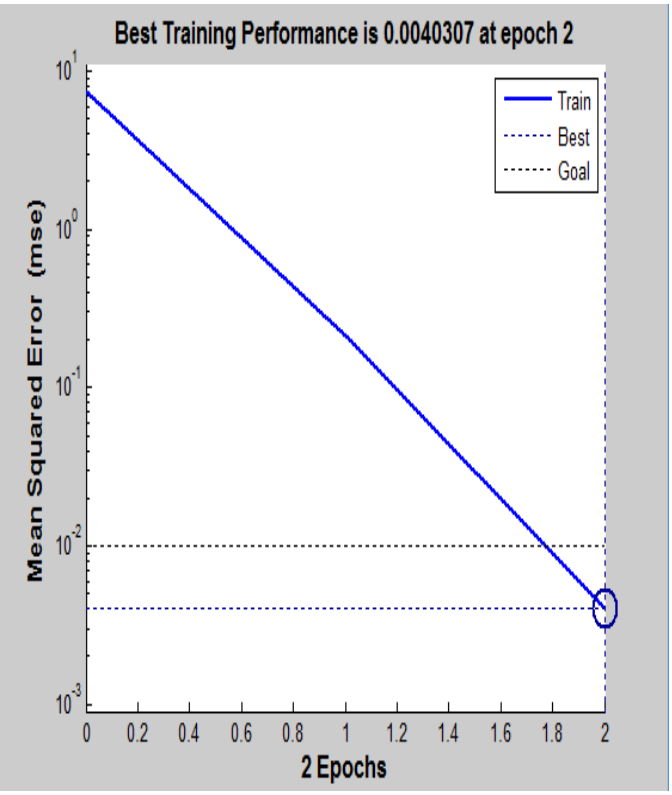

Figure 4: Error v/s epoch curve for Levenberg-Marquardt learning rule

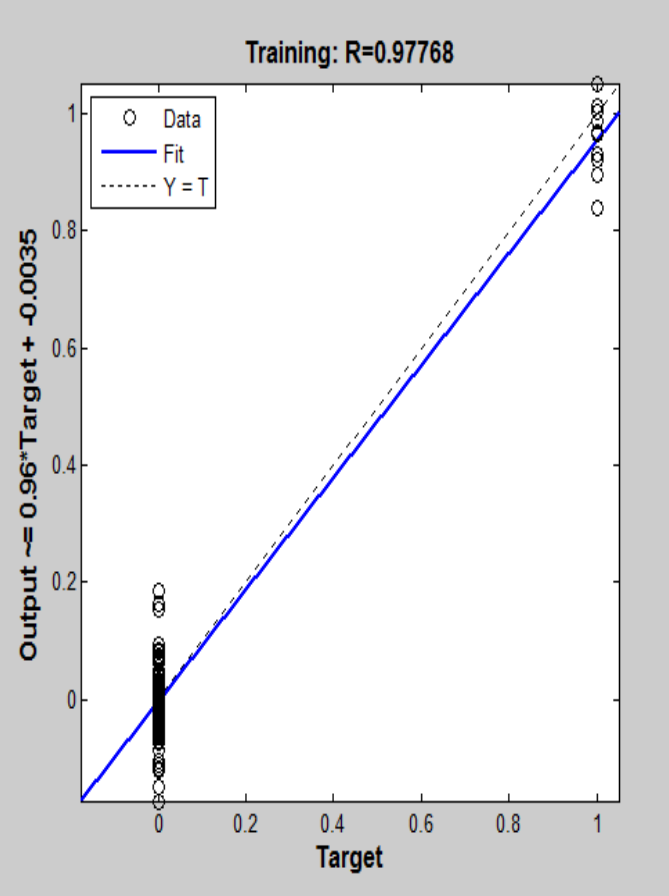

Figure 5: Regression characteristics Levenberg-Marquardt of learning rule

Table 2: Testing results for Levenberg-Marquardt learning rule

	Character tested	Regression	Accuracy (%)
1	A	0.944	100
2	B	0.972	100
3	C	0.947	100
4	D	0.841	100
5	E	0.891	100
6	F	0.897	100
7	G	0.874	100
8	H	0.877	100
9	I	0.954	100
10	J	0.978	100
			100% (Avg)

VII. CONCLUSION & FUTURE SCOPE

In this research paper an attempt was made to develop an artificial neural network based system for character recognition. Using L-M algorithm that was used to train feed-forward multilayer back-propagation neural network. The L-M method provide more stability in the error performance at different learning rates and better performance with 100% accuracy rate for recognition of printed English alphabet characters.

In future scope, we plan to explore in the field of recognition of handwritten characters and textured characters in different languages with most efficient results.

VIII. REFERENCES

[1] Badi, m. Boutalline and s. Safi, "The Neural Networks: Application and Optimization Application Of Levenberg-Marquardt Algorithm For Tifinagh Character Recognition", International Journal of Science, Environment and Technology, Vol. 2, No 5, 2013, 779 –786, ISSN 2278-3687 (O).

[2] Batsukh Batbayar and Xinghuo yu, "An Improved Levenberg-Marquardt Learning Algorithm for Neural Networks Based on Terminal Attractors", 1-4244-2386-6/08/$20.00 ©2008 IEEE.

[3] Gaganjot kaur and monika aggarwal, "Artificial Intelligent System For Character Recognition Using Levenberg-Marquardt Algorithm" ,International Journal Of Advanced Research In Computer Science And Software Engineering , Volume 2, Issue 5, May 2012, ISSN: 2277 128x.

[4] Suruchi G. Dedgaonkar, Anjali A. Chandavale and Ashok M. Sapkal, "Survey of Methods for Character Recognition", International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 5, May 2012, ISSN: 2277-3754.

[5] Julio C Rodriguez-Quinonezn, Oleg Sergiyenko, Felix F. Gonzalez-Navarro, Luis Basaca-Preciado and VeraTyrsa, "Surface recognition improvement in 3D medical laser scanner using Levenberg–Marquardt method" , 0165-1684/$ - seefrontmatter & 2012 Published byElsevierB.V.

[6] Y. Fujisawa, Meng Shi, T. Wakabayashi and F. Kiruma, "Handwritten numerical recognition using gradient and curvature of gray scale image," in Proc. 5th Int. Conf. Document Analysis and Recognition, pp. 277-280, 1999.

[7] U. Pal and B B Chaudhuri, "Indian script character recognition: a survey," Pattern Recognition, 37 (9), 2004, pp. 1887-1899.

[8] Y. Hamamoto, S. Uchimura, S. Tomia, "On the behavior of artificial neural network classifiers in high dimensional spaces," IEEE Transactions Pattern Analysis and Machine Intelligence, 18, 5, pp. 571-574, 1996

[9] Rafel. C. Gonzalez and Richard E. Woods, Digital image processing, 3rd Ed, Prentice Hall, 2006

[10] Yogesh Tayal, Ruchika Lamba, Subhransu Padhee, "Automatic face detection using color based segmentation," International Journal of Scientific and Research Publication, vol. 2, no. 6, 2012, pp.1-7.