

Application of Artificial Neural Networks in Recognition of Isolated Dari Characters

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Abstract—Researchers have been working on patterns recognition systems around the globe. Artificial neural networks (ANNs) is one of the advance techniques for pattern recognition systems. In this article we have used ANN for the recognition of scripts of Dari language, which is spoken in Afghanistan. Dari language has a script similar to that of Urdu, Arabic, Persian and Pashto. A database of Dari language isolated characters has been developed using MATLAB. An ANN has been used for recognition of Dari language isolated characters. The network was trained on six Dari fonts. The maximum detection accuracy achieved for the images which were included in the training set was 100% and the maximum efficiency achieved for the images which were not included in the training set was 91%. It may be concluded that efficiency can be improved by selecting the optimum size of the training data set.

Keywords—Application, Artificial, Cursive, Neural, Optical, Pattern, Recognition

1 INTRODUCTION

COMPUTER vision has attracted the scholars, scientists and engineers due to the wide range of applications and usage. Applications may include digital image processing, data mining, pattern recognition, artificial intelligence, machine learning and robotics, automation, medical applications etc [1-6]. Pattern recognition in combination with image processing is the key of computer vision[7-9]. From the last few decades artificial intelligence (AI) is attracting the focus of scholars. Modern AI systems are mostly based on real time image processing and pattern recognition. These systems get input from the real world in the form of images and transform it to computer readable and computer understandable data. And the machine acts as per the instructions mapped with the input data. Digital image processing is processing of raw image in such a way that important information is extracted from it [10]. Different computer algorithms have been used for image processing [11, 12]. Digital Image processing is a process in which input to the system is an

image and output is also an image with improved and enhanced quality and features[13]. Pattern recognition is based on the data extracted from images in image processing. Different techniques have been used for pattern recognition among which artificial neural networks (ANNs) are supposed to be the more sophisticated classifiers[14, 15]. Due to wide range of applications i-e (face recognition[16,17], English characters recognition[18-20], Urdu characters recognition [21], Chinese recognition[22], Hindi recognition[23, 24], Bangla, Arabic[25, 26]) ANNs have attracted the focus of scholars. In this paper, application of ANNs for recognition of Dari language is discussed. Dari language is spoken in Afghanistan as well as some areas in Iran[27]. 50 % of the

population of Afghanistan speak Dari language (about 12 million). The language has script similar to that of Urdu, Arabic, Persian and Pashtu. This language has 32 characters as shown in Figure 2. A database of Dari language characters has been developed using MS Word and MATLAB. Image having Dari characters was imported into the Matlab, after necessary processing it was passed through the Neural Network and the network was trained. After training the network was tested and results were obtained.

2 METHODOLOGY

2.1 Proposed Methodology

Initially a database of Dari Characters was developed. Then these images were pre-processed, quality of the images was enhanced then segmented into characters, features were extracted, and the Neural Network was trained. After training images were tested and results were obtained. The block diagram in Figure 1 shows the flowchart of the adopted methodology.

2.2 Database of Isolated Dari Characters

A database of isolated Dari characters was developed using MS Word and Matlab as tools. Database was composed of all 32 characters of Dari language and these characters were typed in Microsoft word software. All the characters of Dari language with their pronunciations are shown in Figure 2. This whole character set was saved in nine different Dari font styles. i-e (Titir, Koodak, Nazli, Roya, Terafic, Calibri Body, A Kunar, Bahij Uthman, Bahij Droid). Typical images of the fonts are shown in Figure 3. These characters were saved in the picture format (jpg). The Size of the characters was kept 36" in MS Word. After creation of the database these images were imported into MATLAB for processing.

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Figure 1 Block Diagram of Methodology

2.3 Image Processing

The next step after development of the database was image processing. Image processing is a process in which an input image is enhanced in features like overall quality of an image, color transformation, brightness, contrast, noise removal, color levels etc. Image processing can be divided into subdivisions as pre-processing, segmentation and features extraction for recognition systems.

Titr	ا ب پ ت
Koodak	ا ب پ ت
Nazli	ا ب پ ت
Roya	ا ب پ ت
Terafic	ا ب پ ت
Calbri (body)	ا ب پ ت

Figure 3 Typical Image of Dari Fonts

2.4 Image Aquisition

An image can be acquired using an image sensor (camera an optical device) or it may be acquired using a mechanical device like typewriter or a stamp. The acquired images were input into MATLAB for processing. Some important steps which were taken for the image quality enhancement and preparing it for analysis is discussed in the following sections.

2.5 Pre-processing

First step in preprocessing was the conversion of a colored (RGB) image into a grayscale image. The RGB images were converted into greyscale images. A grayscale image has smaller size and dimensions which is therefore easy to handle it in further processing and transformation. After gray scaling a more simplified image can be obtained by converting it into a binary image. A binary image is a digital image which is composed of only two levels i-e one and zero. Zero represents black color pixels and 1 represents white pixels of a digital image. The data of

binary images were stored in matrixes form for further processing and calculations.

ت	پ	ب	ا
Te	Pe	Be	Alef
ح	چ	ج	ث
He	Che	Jim	Se
ر	ذ	د	خ
Re	Zal	Dal	Khy
ش	س	ژ	ز
Shin	Sin	Zhe	Ze
ظ	ط	ض	ص
Zoy	Toy	Dwad	Swad
ق	ف	غ	ع
Qaf	Fe	Ghayn	Ayn
م	ل	گ	ك
Mim	Lam	Gaf	Kaf
ي	ه	و	ن
Ya	He	Waw	Nun

Figure 2 Dari Characters set with Pronunciation

2.6 Image Segmentation and Features Extraction

Segmentation is a process of division, in which the whole image is segmented into small parts of interest. The images stored in our database were composed of all the characters

in a single image, so it was necessary to obtain single characters from the image. Due to dots in some of Dari characters, dilation was used for merging the dots into the parent characters. Dilated version of each binary image was obtained, and the characters having dots were dilated till the dots of that specific character. After dilation four cropping points for each character were calculated and these points were used for cropping the input binarized image. In such a way each input image of Dari characters set was segmented into single characters and each character was stored as a single image object in a matrix. These character images were resized to an optimized size of 40x50 pixels. These characters were used for the training of the neural network.

3 Training

3.1 Neural Network Training

The designed neural network was composed of three layers (input, hidden and output layers). Number of nodes/neurons required in each layer was calculated as per the requirements i.e input layer was composed of 2000 nodes because the number of bits in the input were 2000. Number of nodes at the output layer depends on the number of classes to be identified. The network designed in this study has 5 nodes in the output layer. Each node gives a binary value of 1 or 0. The neurons at the output layer gives a series of 5 binary bits which are then compared with the desired pattern of binary number. Number of nodes in the hidden layer was optimized. Good results i.e minimum error was achieved at 90. The neural network was trained on the database images. After 8000 iterations the training error was reduced to the minimum level and the network was trained. The error was minimized to a lowest value of 10-14. The error minimization curves for the training set are shown in Figure 4. Number of iterations are shown on x-axis and mean squared error values are shown on the y-axis. These curves show the last 1000 iterations of the training process.

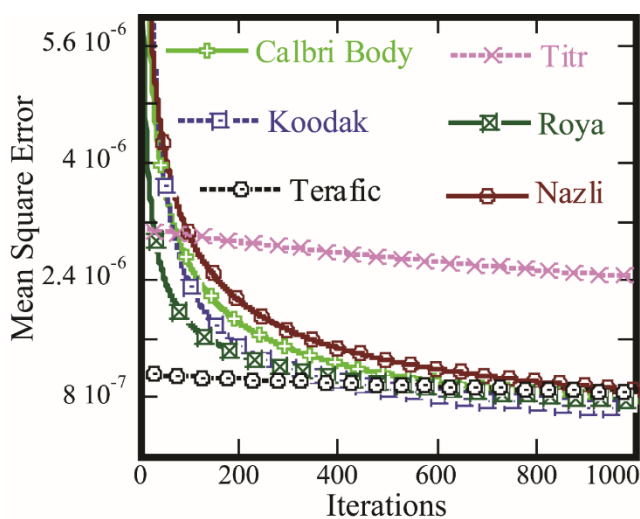


Figure 4 Error Chart

3.2 Error Back Propagation and weights

For achieving minimum error, back propagation technique was used. In training process the signal was first propagated in the forward direction using sigmoid function and output was calculated. The output was compared with the actual value and error was calculated. The error was then backpropagated in the network and new weights were found and updated. This process was an iterative process and was repeated till the achievement of goal error. The following equation shows the error.

$$e = A - O \quad (1)$$

where e is the error

A is the desired output

O is the calculated output

Weights were updated according to the new error values.

4 Results

4.1 Recognition

The neural network was tested on the data base images as well as on new images with different font style of Dari characters. Titr, Koodak, Roya, Terafic, and Calbri Body were the images from the database and A Kunar, Bahij Droid and Bahij Uthman were the test images which were not included in the training set. Results showed maximum efficiencies for the images on which the network was trained i.e 100% for Calbri font, 100% for Terafic and 100% for Titr font. Similarly, 91% accuracy rate was achieved for A Kunar font. Table 1 shows the recognition efficiencies of different fonts styles tested on the network.

Table 1 Recognition Efficiencies of Fonts

S.No	Font Style	Efficiency
1	Calbri	100 %
2	Titr	100 %
3	Roya	96.87 %
4	A Kunar	90.62 %
5	Bahij Droid	62.5 %
6	Bahij Uthman	59.37 %
7	Terafic	100 %

5 Conclusion

This paper reports the recognition of Dari language characters by applying image processing and artificial neural networks. It may be concluded that the size of data set for training the network affects the recognition rates i.e if the data set contains more characters and fonts the high is the recognition rate and vice versa, but it may take a very huge time for training the network and very high-speed computer will be needed to achieve good results. In this study 6 fonts were included for training of the network. It may also be noticed that the efficiency for bold fonts and characters are slightly more than narrow and thin fonts.

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