Recognition of Farsi Letter using Hidden Markov Model

Sadegh Zarezade
Islamic Azad university of Larestan, Larestan,Iran

Abbas Akkasi
Islamic Azad university of Larestan, Larestan,Iran

Ayoob Maher
Islamic Azad university of Larestan, Larestan,Iran

Yalda Namdar
Islamic Azad university of Larestan, Larestan,Iran

ABSTRACT
Letter recognition is taken from optical character recognition (OCR). Some of the applications like devices which read postal code and checks are limited to recognition of numbers and need high speed and accuracy. In current paper the combination of two powerful method i.e. hidden Markov model will be used. Other models are used only in recognition of English words in learning using online method. The accuracy of recognition is 93% for Ifn/Farsi Database.

Keywords
Recognition, Farsi letters, hidden Markov model

1. INTRODUCTION
Farsi Is the major language of Iran and Afghanistan and over 110 million populations including some people in Tajikistan and Pakistan speak it. Due to widespread use of this language some researchers became interested in studying problems related to recognition of Farsi handwriting [3]. Most of the work in this area devoted to recognition of Farsi texts, while this study is on the recognition of Farsi letters.[12]

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In Figure 1 and 2 a Farsi letter is demonstrated in written and printed versions.

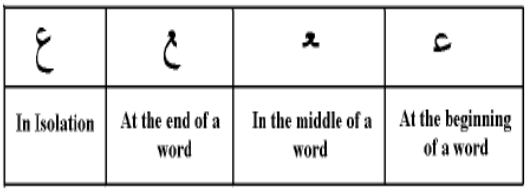

Figure 1: A models of Farsi letter

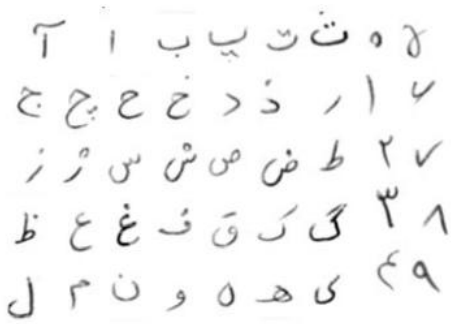

Figure 2: An models of Farsi letter

Al-Omari et al used probable neural network (PNN) for Arabic language. Their database comprised of 720 digits which could achieve 99.75 % accuracy. Said et al [10] used images with the size of 16×20 for achieving that feature. They used artificial neural network (ANN) which in it hidden neurons were employed in a dynamic way. the accuracy of their method was 94%. Liu et al recently propose a new criterion for recognition of Farsi handwriting. In this method they used the CENPARMI database. The error was low and they reach 84% accuracy. Drucker et al [11] worked on the textual retrieve using SVM. In this paper the method of HMM is used. Regarding our researches this method only was used for recognition of English words in a dictionary by Ahmad [3]. Nobody used this method for recognition of letters.

Our approach to OCR is a form of iterative contextual modeling, building a document-specific model by first recognizing the least ambiguous characters and then iteratively refining the model to recognize more difficult characters.

In second part of paper HMM will be discussed. In third part the model of HMM will be addressed and finally demonstrated results and a model for recognition of letters will be presented.

2. HIDDEN MARKOV MODEL
Hidden Markov Models (HMMs) are now widely used in

off-line handwritten recognition. Given a word image, it is first transformed into a sequence of fixed-dimension feature vectors, and then fed into a word HMM-based classifier to decide on its most probable word.

All material on each This method is based on adjustment of image templates on links of a stochastic rehidden model. According to figure 3, HMM categorizer comprised of a lot of possible situations of Q={q1, Λ, qk } and the possible transitions between these situations. If we suppose that there are “k” situations, every of these situations have a Probability Distribution in the form of p(x| qk) . this probability is usually used by Gaussian Probability Density Function combinations as the probability of HMM distribution. One of the methods for training Gaussian parameters is the maximizing of similarities. It means that the combinations are taught for every class data rather than separating one class from the others.

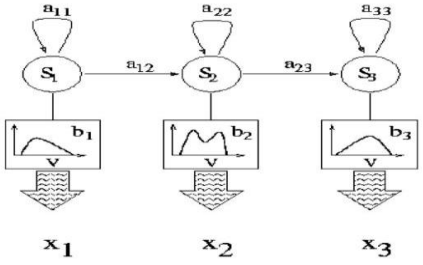

Figure 3: A Hidden Markov Model

3. A NEW MODEL OF HMM

For recognition of letter with HMM were used alone. In our suggested method a more optimum method is presented. First, the extant letters in database should be segmented. A powerful method of segmentation has been used to have less calculation in processing phase.

Figure 3 shows the method of segmentation. In this method the image was segmented into 5 equal parts.

Figure 4: A new model for segmentation

In the training phase, letters have been put into classes by HMM. Some hypothesis have been received after doing pre-processing on the extant data and training with the linear HMM. The extracted hypothesis is recognizable through HMM Gaussian model.

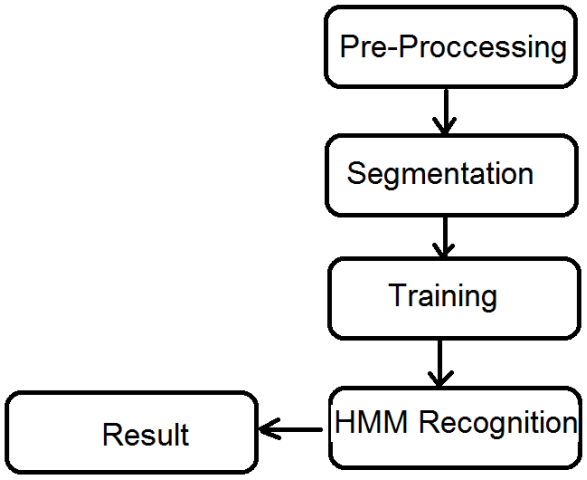

Figure 5: Model of Recognition

Figure 4 presents the procedure of implementing the algorithm. According to this figure in part 1 decent approximation has been achieved by using HMM and in part 2 the character is recognized by using HMM.

When it was supposed to use Hidden Markov Model, the calculated probabilities are used as the inputs of model and the hidden model do the recognition regarding to these probabilities.

4. DATABASE

In current paper two databases have been used for recognition of Farsi letter including Ifn/Farsi.

Ifn/Farsi is a Persian database for letters. The handwritten letters of this database are extracted from 100 writers with various ages and genders.. Some of the samples of this database are shown in figure 6.

Char label (Char)
Alif (ا)
Baa (ب)
Taaa (ت)
Thaa (ث)
Jiim (ج)
Haaa (ح)
Xaa (خ)
Daal (د)
Thaal (ذ)
Raa (ر)
Zaay (ز)
Siin (س)
Shiin (ش)
Saad (ص)
Daad (ض)
Thaaa (ط)
Taa (ظ)
Ayn (ع)
Ghayn (غ)
Faa (ف)
Gaaf (ق)
Kaaf (ك)
Laam (ل)
Miim (م)
Nuun (ن)
Haa (ه)
Waaw (و)
Yaa (ي)

Figure 6: Sample of Database

5. CONCLUSION

Following conclusions have been achieved After studying different methods with these database.

According to table 2 which is based on ifn/farsi, all the results are assessed well, but these methods has fluctuated for noise and rotation and the effectiveness declined.

In this database the result is 93% accuracy and 85.76% accuracy for times which there are rotation or change in images. Both of them are similar to SVM and are better than KNN. However, this method is better in speed of implementation and complexity in comparison with other extant methods. This is due to using the simple linear methods one-dimensional HMM (in contrast to multi-dimensional) which decrease the calculations.

Table 1: Sample of Database

Ref	Property	Methods	Without noise (%)	Error (%)
[12]	Gradient	SVM	81.42	18.58
[12]	Avg.accuracy	SVM	88.11	11.89
[12]	Gradient	KNN	83.90	16.1
[12]	Avg.accuracy	KNN	87.90	12.1
-	Gradient	HMM	85.76	14.24
-	Avg.accuracy	HMM	93	7

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