Learning Enhancement of Online Handwritten Telugu Character Modeling for Various Features Sets

Goda Srinivasarao, Rajeswara Rao Ramisetty

Abstract— Feature extraction plays vital role in online hand written character recognition. Local Features captured through co-ordinate system approach plays significant role in determining the online telugu character recognition. In this paper, we have instigated the performance of various features using Artificial Neural Networks(ANNs). ANN model is tested with various combination such as (x,y) co-ordinates , pen-up and pen-down $(\Delta x, \Delta y)$, $(\Delta^2 x, \Delta^2 y)$. ***Finally it is observed that*** $(\Delta^2 x, \Delta^2 y)$ ***features have given better accuracy. 95.18 % performance is obtained for 300 epochs for 52 Telugu characters. The database used for the study is HP-online Telugu database.***

I. INTRODUCTION

Though languages like English can be or given as an input to the computers to execute as commands or process the data. It is not the same for quite a few languages like Telugu, Chinese, Hindi and other Indian or Japanese languages. Because these languages involve lot of stroke variations from writer to writer. But, rather than giving input via keyboard or voice, it is advisable to give it via handwritten samples (like parchments of paper or electronic pens). For instance, entering data into the database from the hand-filled Railway-reservation applications is a tedious task and can be automated. Moreover, properly trained systems will be capable of recognizing the hand-written text better than that of the human. And this handwriting recognition is plays a crucial role in the human computer interaction model. Efforts have already been made to build system in both online and offline fields for achieving various aims, like recognizing numeric characters, language recognitions like Assamese[1], Thai[2] and Arabic [3].

Unlike English, the basic telugu handwritten characters consists of 16 vowels and 36 consonants The characters in telugu content are a mix of these fundamental characters and their modifiers which offers ascend to around 18,000 unique characters. These unique telugu characters can be represented as a combination of a manageable set of 235 strokes. The character strokes, other the first stroke taken as main stroke, can be divided, based on the position of the stroke, into three - top stroke, bottom stroke and baseline stroke. As a preliminary attempt, we use character based recognition for on-line handwriting recognition of Telugu which is a very popular south Indian language, in which much research has not yet done.

Telugu language found in the South Indian states of Andhra Pradesh and Telangana as well as several other neighboring states. Subset Telugu symbols given in the following figure 1.In Telugu script, many of the characters resemble one another in structure. Further, many users write two or more characters in a similar way which can be difficult to classify correctly. In Telugu some of the confusing pairs are there . An SVM based stroke recognition method used in [1] for Telugu characters. Based on proximity analysis, the recognized strokes are mapped onto characters using information of stroke combinations for the script. Each stroke is represented as preprocessed (x, y) coordinates. The data sample size 37817 was collected from 92 users using the SuperpenTM, a product of UC Logic. The observed recognition accuracy is 83%. Importance of annotation of online handwritten data illustrated in [5]. Modular approach for recognition of strokes proposed in [6]. Based on the relative position of strokes in the character, the strokes are categorized into baseline, bottom, top strokes. The recognition model SVM was used for each category separately. The recognition accuracy is high for each stage, when compared to combined classifier. Elastic matching technique, DTW used in [7]. The features used are local features: x-y features, Tangent Angle (TA) and Shape Context (SC) features, Generalized Shape Context (GSC) feature and the fourth set containing (x, y) coordinates, normalized first and second derivatives and curvature features

II. FEATURES USED FOR CHARACTER RECOGNITION

In a research area related to pattern recognition Benchmarking database is very important. In Telugu the dataset available is Hp-Labs data in UNIPEN format[4]. The data were collected using AcecadDigimemo electronic clipboard devices using the Digimemo-DCT application. Literature survey shows very less research done using HP-Labs dataset and researchers used their own databases for evaluating their techniques. If the standard database used, it will be good to compare various techniques proposed by the researchers. To increase accuracy some preprocessing techniques can also be applied over this dataset.This dataset contains nearly 270 samples for each of 166 Telugu "characters" written by native Telugu writers. The data are

Revised Manuscript Received on October 15, 2019

Goda Srinivasarao, Associate Professor, Department of CSE, PACE Institute of Technology & Sciences

Dr. Rajeswara Rao Ramisetty, Professor, Department of CSE, JNTUK-UCEV-Vizianagaram

collected using AcecadDigimemo electronic clipboard devices using the Digimemo-DCT application. These 166 symbols are collected from 146 users in two trials. Among these collected 45,219 samples, 33,897 samples are used for training and remaining are used for testing.

A. (X,Y) Co-ordinates

(X, Y) co-ordinates are used for character recognition pupose. HP Dataset provides x ,y co-ordinates for all the telugu characters. Figure 2 depicts some of the sample telugu characters and Figure 3 gives x,y co-ordinates of a telugu character.

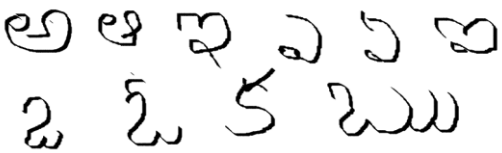
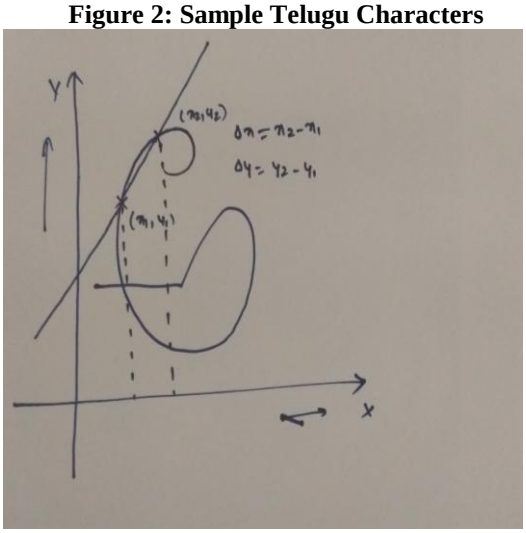
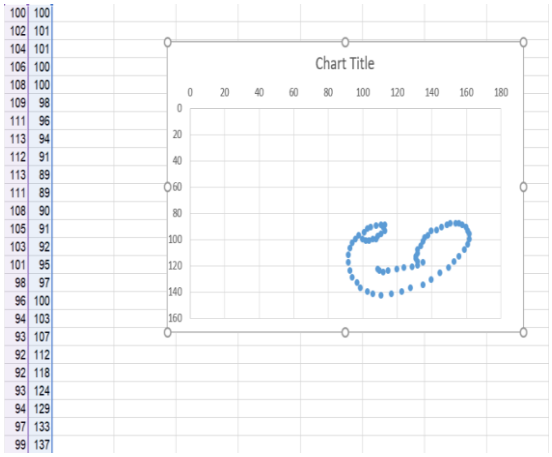


Figure 2: Sample Telugu Characters



(a)



(b)

Figure3: A.(x,y)co-ordinates representation, B. and Co-ordinates

From the given HP Dataset $(\Delta x, \Delta y)$ co-ordinates are extracted from the (X, Y) co-ordinates with the following mechanism as mentioned in Figure 4.

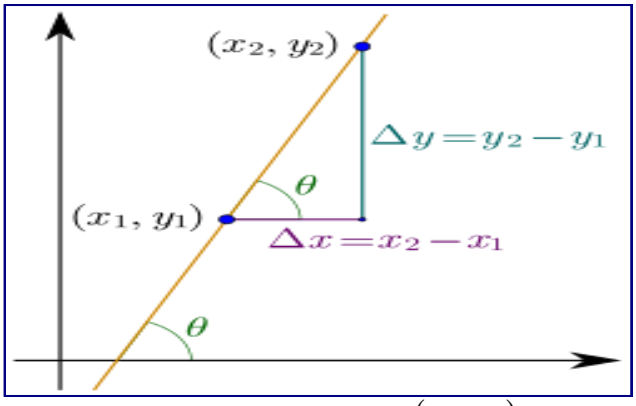


Figure 4 represents the extraction of $(\Delta x, \Delta y)$ from the telugu character. Similarly $(\Delta^2 x, \Delta^2 y)$ co-ordinates are extracted from the given database as mention below.

First Order derivative:

$$x'(j) = \frac{\sum_{i=1}^{2}(x(j+1) - x(j-i)) \cdot i}{2\sum_{i=1}^{2} i^2}$$

$$y'(j) = \frac{\sum_{i=1}^{2}(y(j+1) - y(j-i)) \cdot i}{2\sum_{i=1}^{2} i^2}$$

$$x''(j) = \frac{\sum_{i=1}^{2} i(x'(j+i) - x'(j-i))}{2\sum_{i=1}^{2} i^2}$$

$$y''(j) = \frac{\sum_{i=1}^{2} i(y'(j+i) - y'(j-i))}{2\sum_{i=1}^{2} i^2}$$

Figure 5: $(\Delta x, \Delta y)$ co-ordinates of a Telugu character

III. EXPERIMENTATION & RESULTS

Here in this process, we have used Artificial Neural Networks (ANNs). First features are extracted from both vowels and constants (52 characters) from 112 users are used for training, provided with two sample of each character, The extracted features are trained with ANN by considering four hidden layers as shown in Figure 6

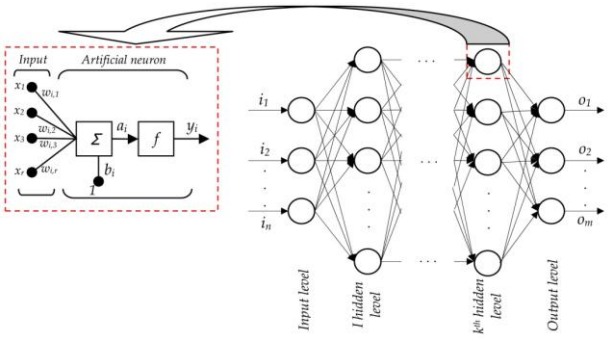


Figure 6: Multilayer Neural Network for Telugu Character Training.

A. Experimental Setup

Tensor flow is used on Windows 10 with I7 HQ processor clock speed of 3.5Ghz, 12 GB of RAM and 2GB Nvidia GTx 950M GPU .

B. Experimental Results

ANN model with four layers have been used for modeling of 52 characters. First it (x,y) co-ordinates are considered.

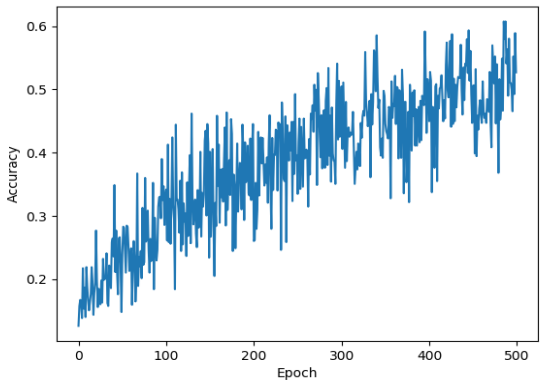


Figure 7: Accuracy of the ANN Model with respect to (x ,y) co-ordinates for 52 telugu characters

From the Figure 7 it is observed that the accuracy of the system is 60.23% for 500 epochs. This is very low. In order to overcome this disadvantages pen-up and and pen-down features are also amalgamated to (x ,y) co-ordinates.

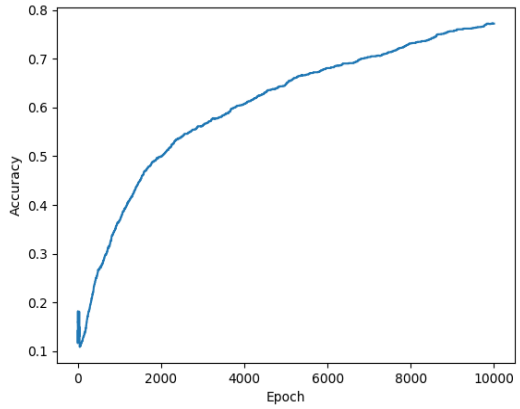


Figure 8: Accuracy of the ANN Model with respect to (x , y) , pen up and pen-down co-ordinates for 52 telugu characters

After considering both (x, y) and pen-up and pen-down co-ordinates, it is observed that the accuracy of the system has been enhanced to 77.18% for 10000 epochs as depicted in Figure 8.

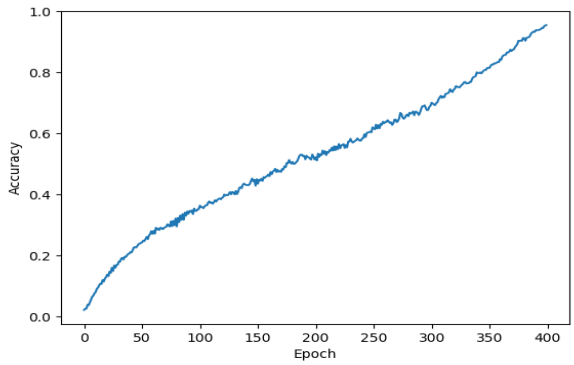


Figure 9: Accuracy of the ANN Model with respect to (x ,y) , pen up , pen-down and $(\Delta x, \Delta y)$ co-ordinates and for 52 telugu characters

Based on these results obtained and as shown in figure 9, it is clearly established that the system accuracy increased abnormally to 88.24 % by considering (x ,y) , pen up , pen-down and $(\Delta x, \Delta y)$ co-ordinates.

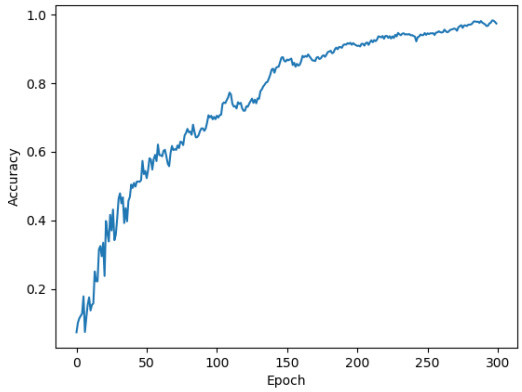


Figure 10: Accuracy of the ANN Model with respect to (x ,y) , pen up , pen-down , $(\Delta x, \Delta y)$, $(\Delta^2 x, \Delta^2 y)$ co-ordinates and for 52 telugu characters 95.18 % performance is obtained for 300 epochs for 52 Telugu characters

IV. CONCLUSION

In this paper we have explored various sets for telugu character modeling using Artificial Neural Networks (ANNs). We have modeled ANN using various feature sets such as (x,y), pen-up and pen-down, $(\Delta x, \Delta y)$ and $(\Delta^2 x, \Delta^2 y)$ co-ordinates by considering 52 Telugu character . For (x,y) co-ordinates modeling of ANN is not that promising. Whereas for the combination of (x,y), pen-up and pen-down co-ordinates promising results are obtained. For (x,y) ,pen-up, pen-down and $(\Delta x, \Delta y)$ significant improvement of 88.24 % is achieved for 400 epochs. Finally 95.18 % performance is obtained for 300 epochs for 52 Telugu characters .

REFERENCES

1. Assamese Online Handwritten Digit Recognition System using Hidden Markov Models, G. Siva Reddy, Bandita Sarma, R. Krishna Naik, S. R. M. Prasanna ∗ and Chitralekha Mahanta Department of Electronics & Electrical Engineering Indian Institute of Technology Guwahati Guwahati-781039, India.
2. Sanguansat, P., Asdornwised, W., Jitapunkul, S. Online Thai handwritten character recognition using hidden Markov models and support vector machines. In International Symposium on Communications and Information Technologies, pages 492–497, 2004
3. Bentounsi, H., Batouche, M. Incremental support vector machines for handwritten Arabic character recognition. In Proceedings of the International Conference on Information and Communication Technologies, pages 1764–1767, 2004
4. http://lipitk.sourceforge.net/hpl-datasets.htm
5. Anand Kumar, A. Balasubramanian, Anoop M Namboodiri, and C.V. Jawahar. Model-based annotation of online handwritten datasets. In Proc. of 10th IWFHR, 2006.
6. Jayaraman, A., Sekhar, C.C., Chakravarthy, V.S.: Modular Approach to Recognition of Strokes in Telugu Script. In: 9th International Conference on Document Analysis and Recognition (ICDAR 2007), Curitiba, Brazil (September 2007)
7. Prasanth, L., Babu, V., Sharma, R., Rao, G. V., and M., D., “Elastic matching of online handwritten tamil and telugu scripts using local features,” in [ICDAR ’07: Proceedings of the Ninth International Conference on Document Analysis and Recognition (ICDAR 2007) Vol 2], 1028–1032, IEEE Computer Society, Washington, DC, USA (2007).